VOLUME LVI NUMBER ONE

THE NATIONAL GEOGRAPHIC MAGAZINE

JULY, 1929

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TWENTY-FOUR PAGES OF ILLUSTRATIONS IN FULL COLOR

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The Sealing Saga of Newfoundland
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TO carry out the purposes for which it was founded forty-one years ago the National Geographic Society publishes this Magazine monthly. All receipts are invested in the Magazine itself or expended directly to promote geographic knowledge.

ARTICLES and photographs are desired. For material which the Magazine can use, generous remuneration is made. Contributions should be accompanied by addressed return envelope and postage.

IMMEDIATELY after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. Four expeditions have followed and the extraordinary scientific data resulting given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, spouting fissures. As a result of The Society's discoveries this area has been created a National Monument by proclamation of the President of the United States.

AT an expense of over $50,000 The Society sent a notable series of expeditions into Peru to investigate the traces of the Inca race. Their discoveries form a large share of our knowledge of a civilization waning when Pizarro first set foot in Peru.

THE Society also had the honor of subscribing a substantial sum to the expedition of Admiral Peary, who discovered the North Pole, and has contributed $25,000 to Commander Byrd's Antarctic Expedition.

NOT long ago The Society granted $25,000, and in addition $75,000 was given by individual members to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees of California were thereby saved for the American people.

THE Society has conducted extensive excavations at Pueblo Bonito, New Mexico, where prehistoric peoples lived in vast communal dwellings before the days of Columbus; it is sponsoring an ornithological survey of Venezuela, and is maintaining an important photographic and botanical expedition in Yunnan Province, China.

TO further the study of solar radiation in relation to long range weather forecastings, The Society has appropriated $65,000 to enable the Smithsonian Institution to establish a station for five years on Mt. Brukkaros, in Southwest Africa.

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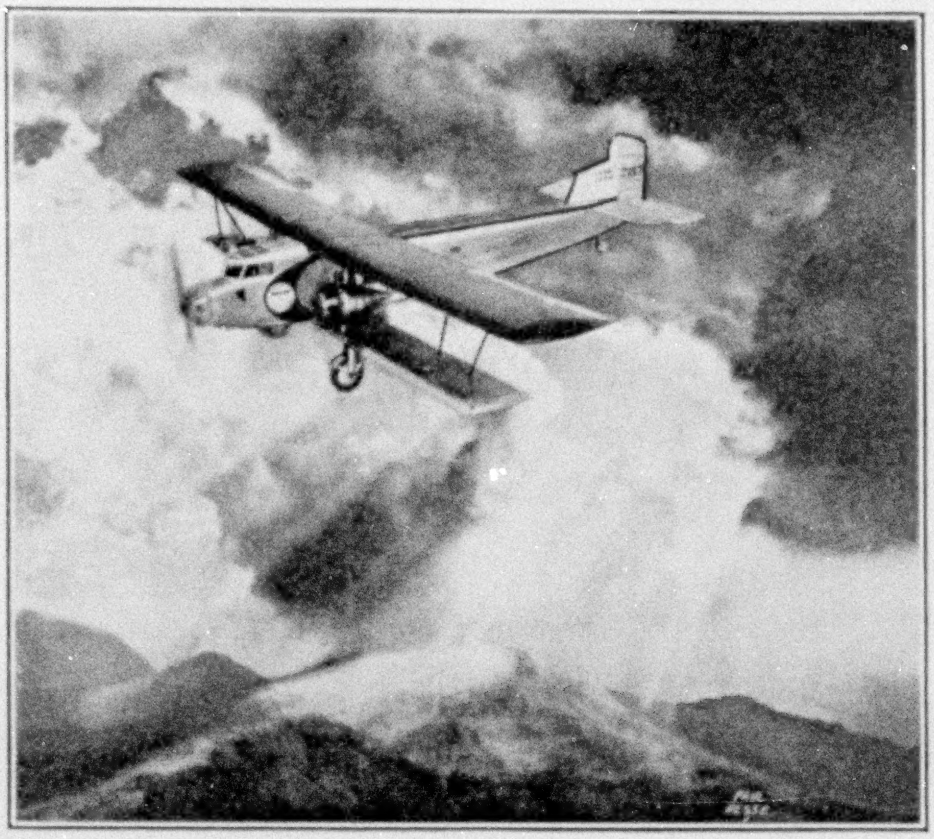
Fog... Murk... Rain... Wind but the Mail goes on!

From

"Coast to Coast with the Air Mail"

by

Dudley Nichols



OUT of storm into sunlight. Like a blue swallow, the shadow of the Air Mail plane darts through the chimney smoke of a house in a lonely valley. Across black fields, farms, forests and the dark meanders of great rivers. Up, up, up—past mountains, eagles and big trees, the three geniuses of earth. Piloted by men who do not know what Fear means.

"A succession of crack pilots," says Author Nichols. "Men who look at their Hamiltons, climb into the cockpit and go out with the mail. On time! Spinning around the great clock as the minute hand goes round the small."

The crack pilots of the Air Mail system—like the pilots of our country's fastest trains—rely on the accuracy of their Hamilton watches in checking the progress of their planes.

Illustrated story—FREE

This exciting story of an *on time* flight from coast to coast, through rain, fog and murk, has been written by Dudley Nichols. Let us send you a copy in booklet form, beautifully illustrated, along with "The Timekeeper," which shows a complete line of beautiful Hamiltons. Address Hamilton Watch Company, 882 Columbia Avenue, Lancaster, Pennsylvania, U. S. A.

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Left—The "Hastings"—In 14k filled yellow or white gold, $55; in 14k gold, $85. Other Hamilton strap watches from $50 upward.

Right—The "Wheatland"—In 14k filled green or white gold, engraved (as shown), $50.

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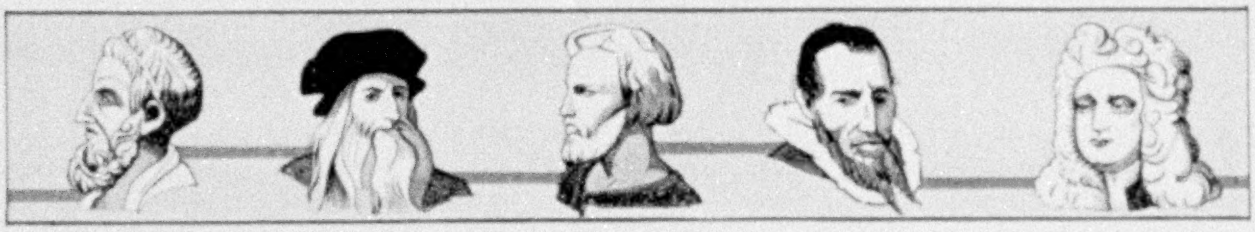
THE HAMILTON WATCH IS AN AMERICAN WATCH

We can thank these *Ancients* for many of our mechanical marvels *including* M*otor* C*ars* . . . .



Archimedes
287-212 B.C.

Leonardo da Vinci
1452-1519

Galileo
1564-1642

Stevinus
1548-1620

Newton
1642-1727

WE are inclined to think of motor cars, radios, phonographs and motion pictures as modern inventions. And they are to a large degree. But they could not have been invented had not many fundamental laws in mechanics, engineering and electricity been established long before these devices were ever thought of.

Motor cars are tremendously indebted to the past. Consider, for example, just the transmission.

Many people, not mechanically inclined, would probably say it was like a box of gears. So it is and gears remind us of something we had almost forgotten. It is generally taught when we study elementary physics. It is this:

Every machine can be reduced to a few simple elements, called the Six Mechanical Powers. The primary ones are the lever, inclined plane and pulley. The others, derived from these, are the wheel and axle (derived from the lever) the wedge and the screw (both derived from the inclined plane).

We are indebted to Archimedes, Galileo, Leonardo da Vinci, Stevinus, Newton and other celebrated mathematicians and scientists of the past for formulating the principles of the six Mechanical Powers and developing their application so that we can use them today in our numerous machines in ways the ancients never dreamed of.

Gears in their operation hark back to the lever principle. And it is common knowledge that gears are one of the oldest methods of power transmission for short distances.

Transmissions have been doing this sort of a job ever since the first car reached the street, but, while there have been many improvements in transmissions during the intervening years, there was still much to be desired until Cadillac-La Salle engineers developed their new *Syncro-Mesh Silent-Shift Transmission.*

What was particularly needed was a transmission that could fully meet the demands of these days of high speed and congested traffic. That is exactly what Cadillac-La Salle engineers have accomplished. Only a finger touch is necessary. There is no conscious effort, no time lost, no noise. Driving is simpler, easier, safer, more comfortable.

This new transmission is found only in Cadillac and La Salle cars. If you would like to know more about it any Cadillac-La Salle dealer will gladly accommodate you.

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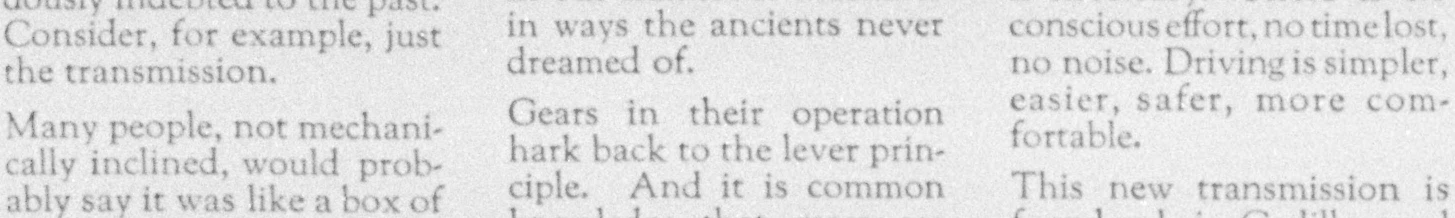
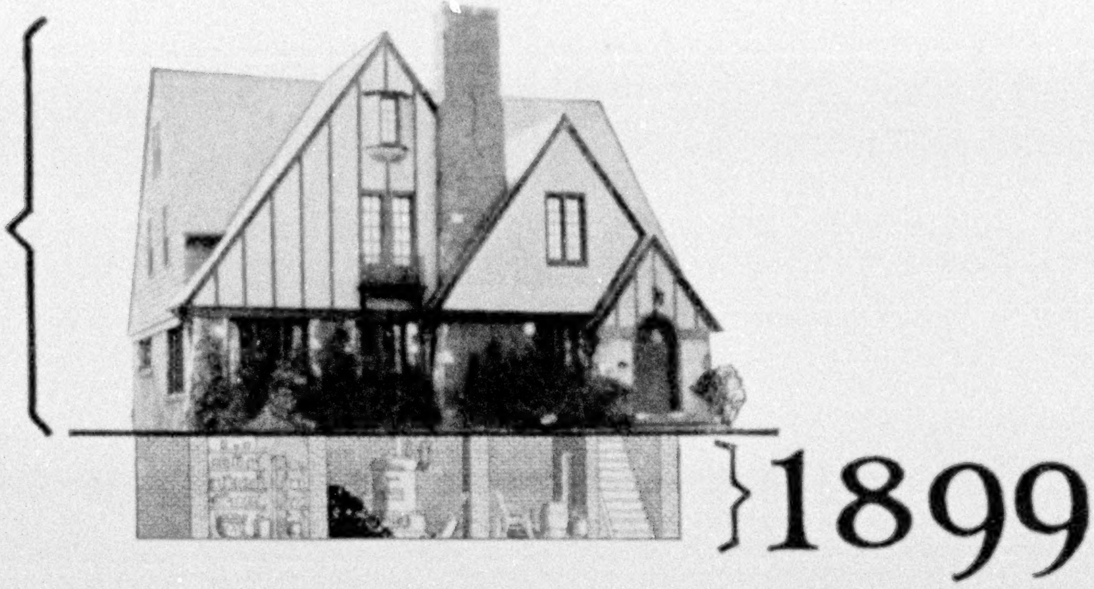
Lever *Inclined Plane* *Pulley* *Wheel and Axle* *Wedge* *Screw*



Don't tie up your Money *in a House like this*



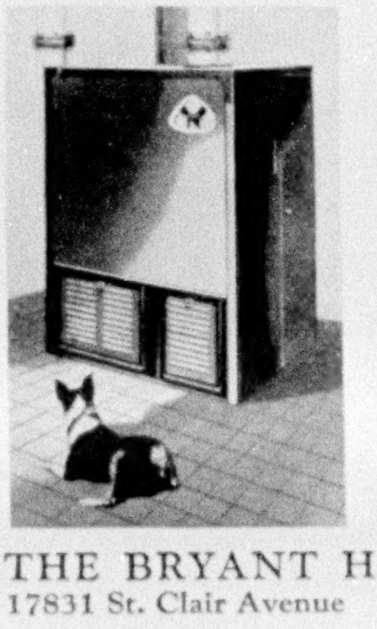
REAL ESTATE men can tell you that for many years the one-bath-room house has been a drug on the market and that the house with a one-car garage is falling in the same category. In two or three years more the house with hand-fired heating is doomed to join them in similar unpopularity.

Even if you hope to live in the house you are planning "from now on," it is only good business to keep re-sale value in mind against a possible unforeseen emergency.

One of the first questions asked by a prospective purchaser is "Does your house heat well?" If you can then lead the way to a spic-and-span, livable basement where a trim, efficient boiler or furnace is on the job, and can testify that the heat it furnishes is absolutely automatic and dependable, you have made a long step toward selling your house at the price to which you are entitled.

Cheap heating plants can, of course, be purchased but they add no sales value to a house. The house with hand-fired heating will soon be refused by up-to-date buyers. Some form of automatic heating is essential to protect the investment in a new residence. The slight additional investment in a plant that admittedly has no superior comes back with a dividend when a house is placed on the market. The easiest time to install such a plant is in the construction financing as a part of the original structure.

By all means install an automatic heating plant but, before buying, get the answer to these questions. How long has it been on the market? How many installations have been in use five years or more? What is their average annual cost for service and repairs? What is the financial standing of the maker? Who, if anyone, will stand behind it in the event that its local representative goes out of business?



Let us send you a complete description of Bryant Automatic Gas Heating—the truly automatic method that, by twenty years of service under all residential conditions, has proved its right to the slogan—"You can let your Pup be Furnace Man!"

BRYANT GAS HEATING

-lets your Pup be your Furnace Man

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FOR you . . . Canadian Pacific presents the most intriguing of cruises.

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What privileged sights! What odd corners! Yet, never are you without your Canadian Pacific service, your 20th Century comforts, your caviar and camembert.

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From New York, Feb. 3, by Empress of Scotland. Feb. 13, by Empress of France. Both 73 days. As low as $900.

The alluring details are in booklets. If you have a good travel-agent, ask him. Information also from any Canadian Pacific office. New York, 344 Madison Ave. . . . Chicago, 71 E. Jackson Blvd. . . . Montreal, 201 St. James St., West . . . and 30 other cities in United States and Canada.

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World's Greatest Travel System

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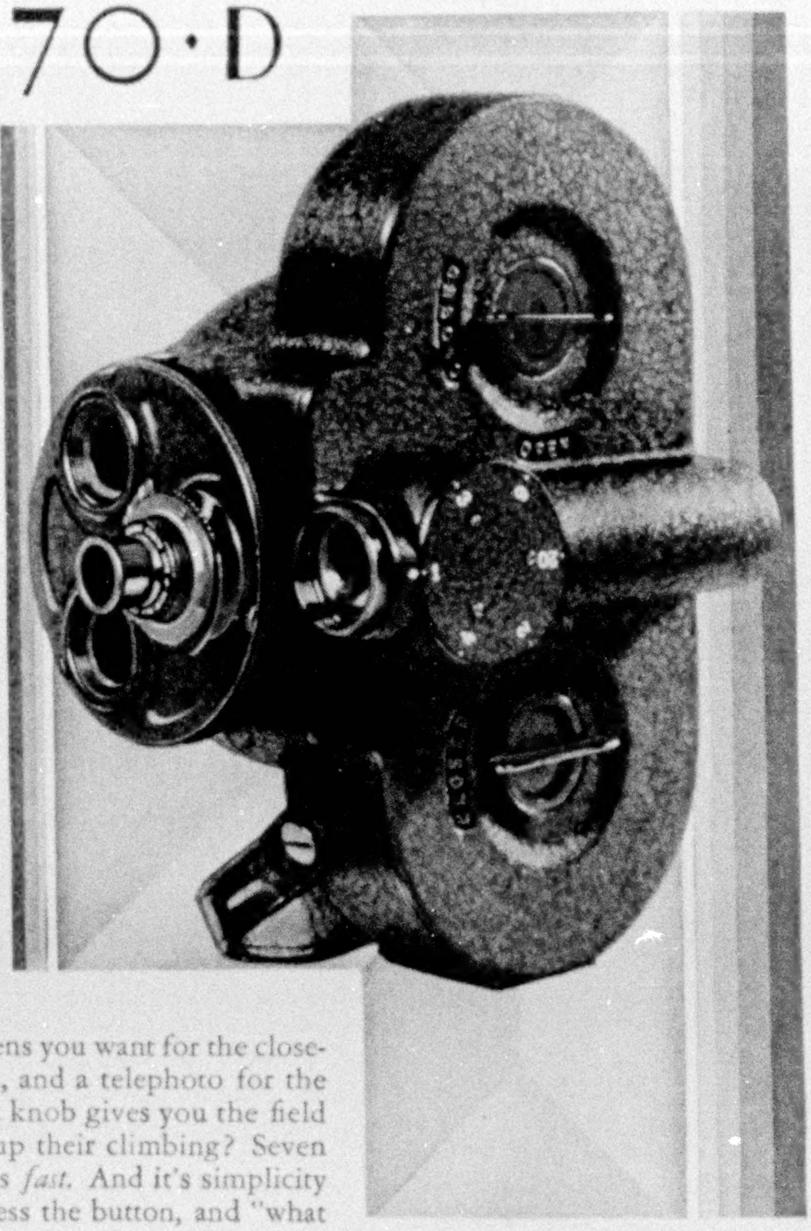
THE NEW 7 SPEED FILMO 70·D

Blaze Your Summer Trail With This Master of All Personal Movie Cameras



© 1927 by Ray-Bell Films, St. Paul

UP . . . up . . . up to meet the clouds! Are you going to lose that victorious scramble over the rocky wall that guards the peak?

Not with the new Filmo 70 D! If you can see them climbing, with the naked eye, you can catch every move with this amazingly flexible movie camera.

A mere turn of its three-lens turret gives you the lens you want for the close-up at the start, a longer lens for a shot midway, and a telephoto for the moment of victory, far away. The simple turn of a knob gives you the field area of the lens you're using. Would you speed up their climbing? Seven film speeds are yours, for s-l-o-w motion as well as *fast.* And it's simplicity itself. Look through the spy-glass viewfinder, press the button, and "what you see, you get." In fact, you get *more* than you can see!

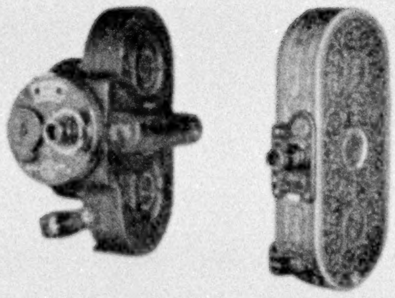
No travel companion you could select will give you so much pleasure as this new Filmo 70 D, the peak achievement of Bell & Howell's 22 years of experience in the manufacture of professional and amateur motion picture equipment.

Its only rivals are Bell & Howell studio cameras, costing up to $5,000, that film Hollywood's leading productions. Yet Filmo 70 D, including one Taylor-Hobson Cooke 1-inch F 3.5 lens, costs but $245 in its smart, Sesamee locked cowhide case with shoulder strap.

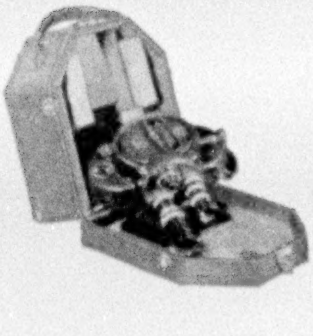
Like all Filmo cameras, Filmo 70 D takes either a 50 or 100 foot roll of film.

Ask the Filmo dealer to demonstrate the new Filmo 70 D, or write for descriptive literature and the illustrated movie booklet, "What You See, You Get."

BELL & HOWELL Co., Dept. G, 1817 Larchmont Ave., Chicago, Ill.
New York, Hollywood, London (B. & H. Co., Ltd.) Est. 1907



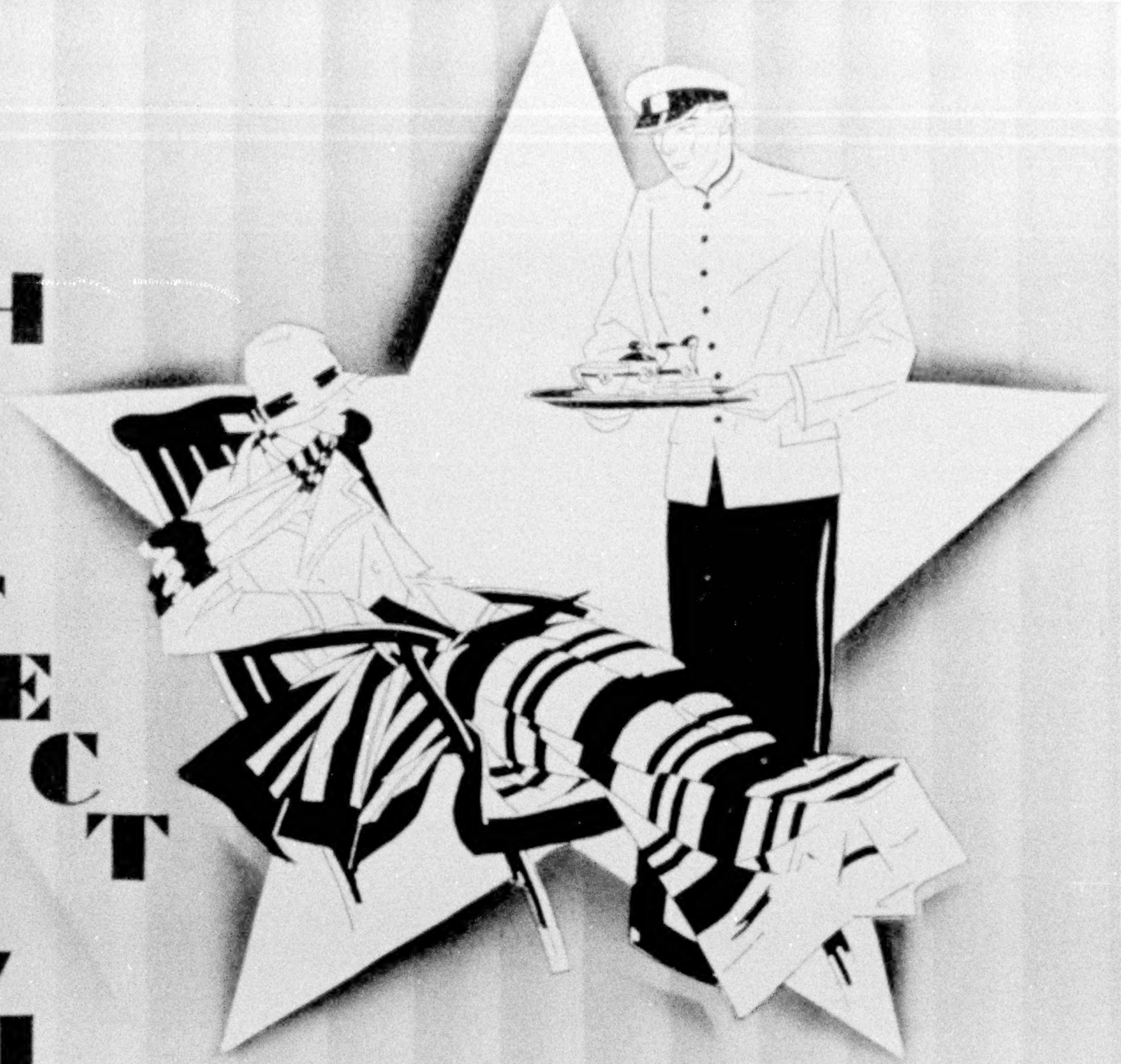
(Left to right) Filmo 70 A, the original personal movie camera, surpassed only by Filmo 70 D, $180 and up with carrying case; Filmo 75, pocket-size and aristocratic, $120 with carrying case.



BELL & HOWELL
Filmo
WHAT YOU SEE, YOU GET

For black and white pictures, Filmo cameras use Eastman Safety film (16 mm.) in the yellow box — both regular and panchromatic — obtainable at practically all dealers' handling cameras and supplies. Filmo cameras and Filmo projectors are adaptable, under license from Eastman Kodak Company, for use of Eastman Kodacolor film for home movies in full color. Cost of film covers developing and return postpaid, within the country where processed, ready to show at home or anywhere with Filmo Projector.

SUCH PERFECT SERVICE



Annual de luxe Winter Cruises: Around the World on *Red Star* liner *Belgenland.* To the Mediterranean by *White Star* liners *Adriatic, Laurentic* and *Britannic* (new). To the West Indies by *Red Star Line,* details to be announced later.

From the little things that always make the feminine heart skip a couple of joyful beats to the big, comfortable things that make life worth living for the men folks . . . your chair in a sunny spot for the all-important sun-bath . . . your morning tub at exactly the right temperature . . . irresistible midnight tidbits in the lounge or cafe . . . such seeming little things but *so* pleasing, account in no small measure, for the increasing popularity of crossings via *White Star, Red Star* and *Atlantic Transport Lines.*

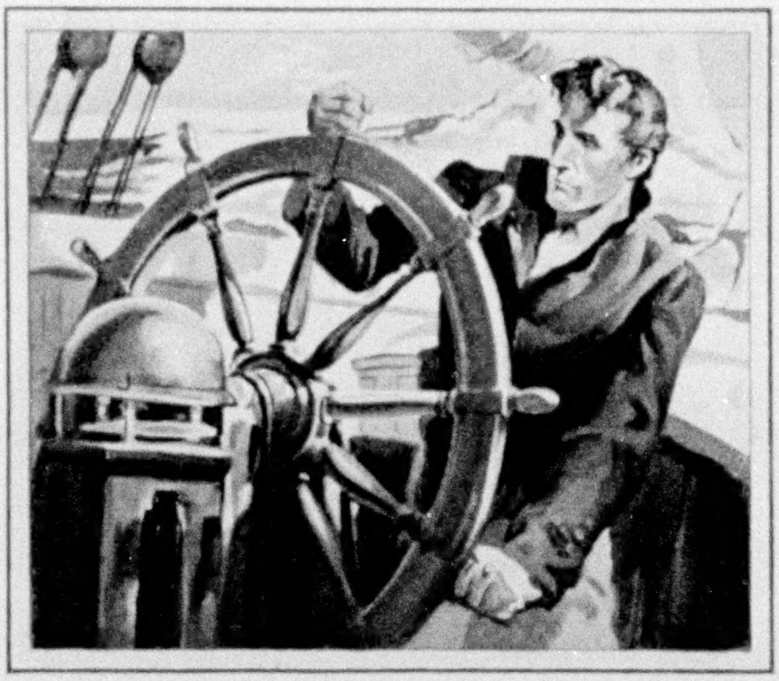
WHITE STAR LINE

RED STAR LINE · ATLANTIC TRANSPORT LINE

INTERNATIONAL MERCANTILE MARINE COMPANY

NO. 1 BROADWAY, NEW YORK; 180 NO. MICHIGAN AVE., CHICAGO; 460 MARKET ST., SAN FRANCISCO; AND OTHER PRINCIPAL CITIES. AUTHORIZED AGENTS EVERYWHERE.

PACKARD



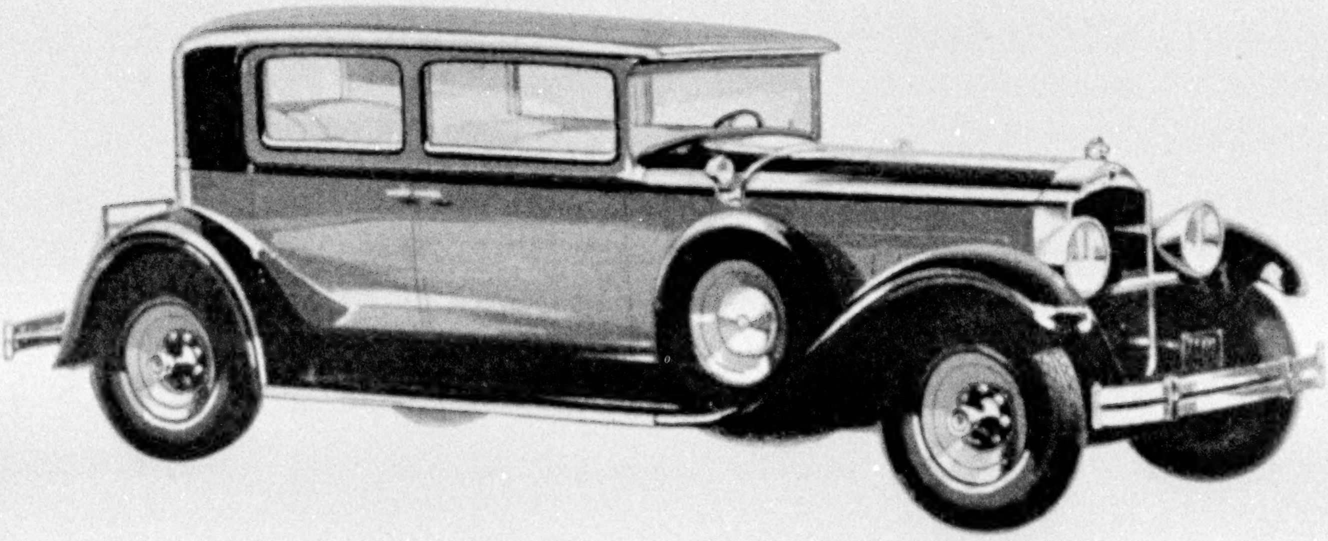
Over uncharted seas New England clipper ships sought and found a rich commerce—establishing permanent trade routes

The log of Packard achievement records the sailing of many uncharted waters—the marking of many new channels of progress for the guidance of an industry. Packard has most often found the way now generally followed.

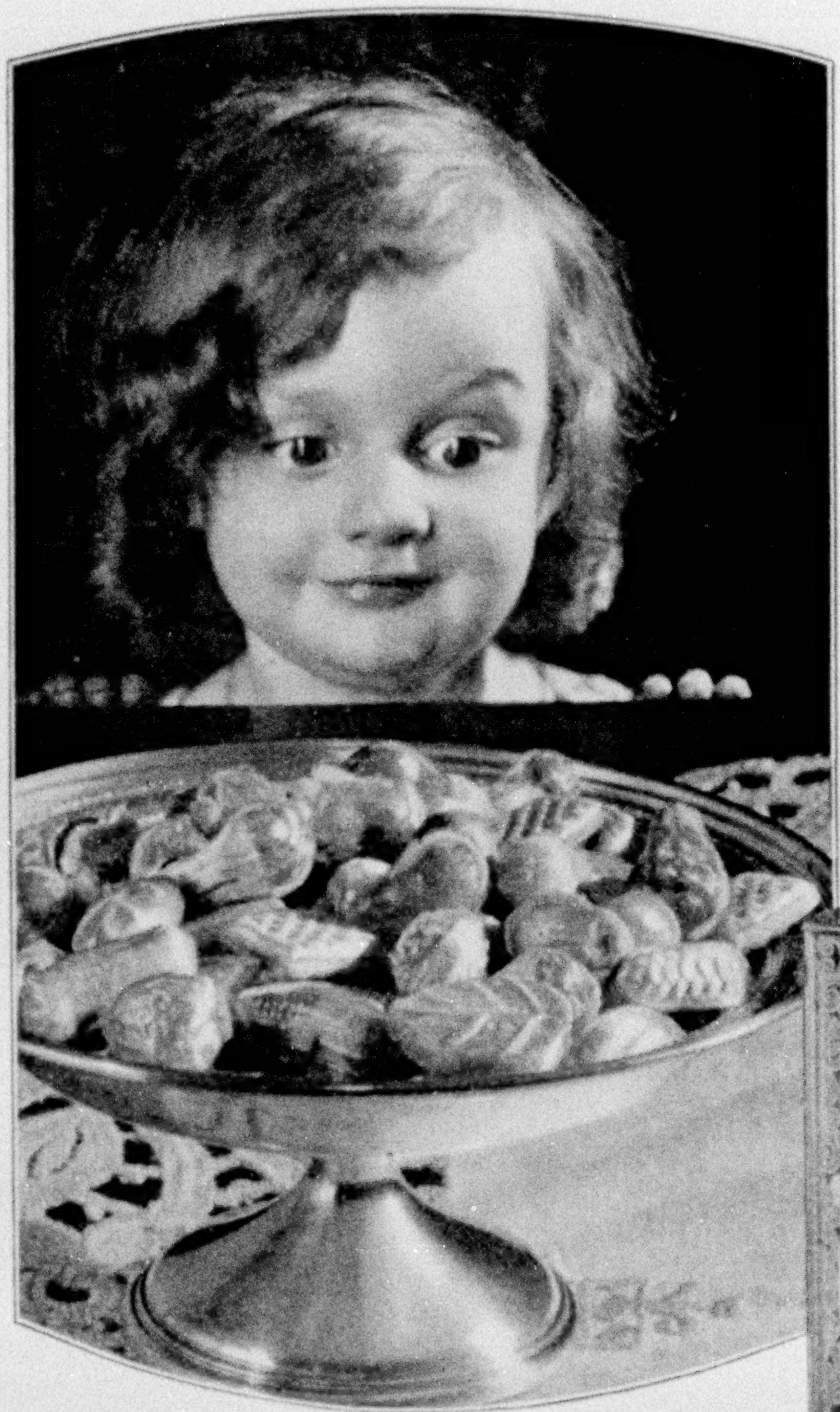
For thirty years a policy of creative research has contributed to Packard supremacy. The automatic spark advance, spiral bevel gears, four wheel brakes, instant chassis lubrication and now a unique and exclusive shock absorbing system—these are but a few of today's proven motor car features originated or sponsored by Packard.

Packard's reputation for advanced engineering and design is firmly established—in the air and on the water as on the highway. Packard's intent is ever to excel—to build for a discriminating and growing clientele a motor car of acknowledged quality leadership, both mechanically and artistically. Those at the helm of Packard management will hold to no other course.

ASK THE MAN WHO OWNS ONE



DIANA "Stuft" CONFECTIONS



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WORLD FAMOUS
CANDIES

*E*AGER eyes sparkle a welcome to these *thin . . . crispy . . . sugar shells . . . "Stuft" . . . with luscious . . . fruit jams . . . nuts . . . and marmalades.* These luscious tidbits, best for children, were originated by Bunte Brothers. Every pound contains 160 pieces—21 distinctly different varieties. Packed in one pound air-tight jars and 2, 3 and 5 pound tins.

If your dealer does not carry genuine Diana "Stuft" Confections, we will supply you. Send 75c for the one pound glass jar. We will gladly mail it postpaid.

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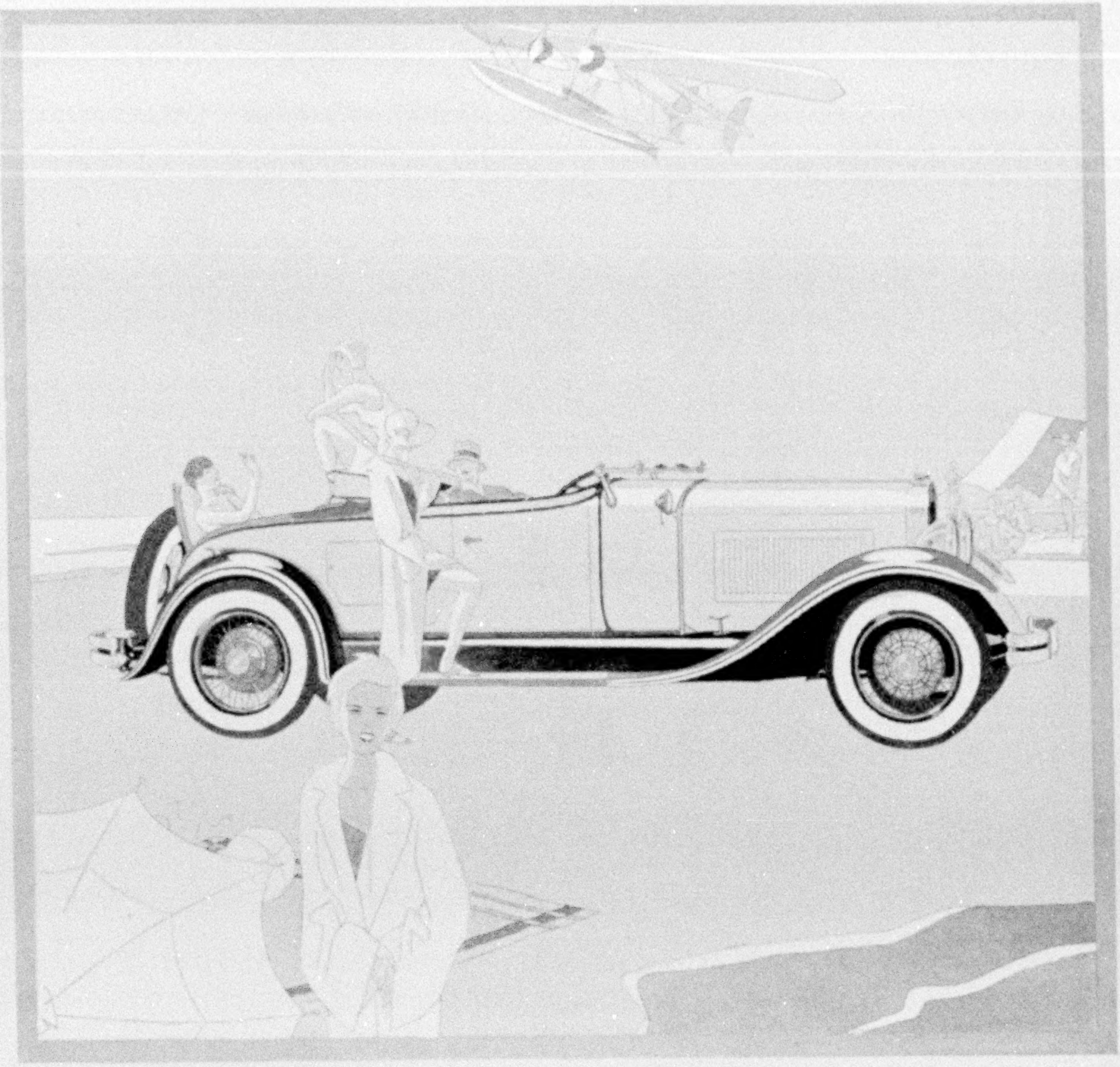
Makers of the famous Mi Choice chocolates

Bunte
DIANA
"STUFT" Confections

DIANA "STUFT" CONFECTIONS

The original "Stuft" confections—often imitated but never equalled

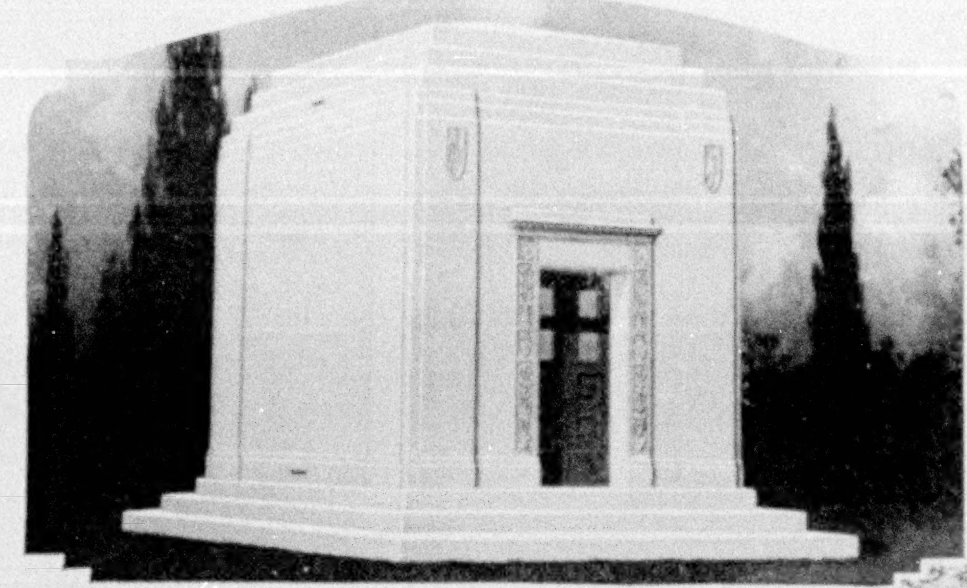


Studebaker President Eight Roadster, $1785. Commander Eight Regal Roadster, $1595. Commander Six Regal Roadster, $1450. On each, 5 wire wheels standard; roomy rumble seat. Commander Six Roadster, wood wheels—$1375. Prices at the factory. Bumpers and spare tire extra.

STUDEBAKER style is the visible expression of Studebaker speed and stamina. Champion performance has won for these great straight eights and sixes *every* official stock car record for fleetness and endurance. Studebaker's artisans have told this inspiring story exquisitely in coachcraft and in color . . . adding the postscript of travel-ease unknown until Studebaker introduced ball bearing spring suspension. With this result: Studebaker now sells *more eight cylinder motor cars than any other maker in the world*—and sells them at low One-Profit prices.

STUDEBAKER

Builder of Champions



Memorial tributes should be enduringly and beautifully wrought, to express most appropriately high hope and deep devotion.

THE gracefulness, beauty of line and modern motif of this Mausoleum define it as a notable structure. Through the genius of Dodds' Memorial Architects, distinguished and uncommon attributes are given to a work of this kind. ¶ The Celtic Cross, in Spring Grove Cemetery, Cincinnati, is a replica of one erected during the late fifteenth century in Oransay, Argyllshire, Scotland. The richness of its design is exquisitely expressed in Stony Creek Granite. ¶ Imperishable Dodds' Granites perpetuate noble tributes through countless generations. There is a wealth of examples in the book, "Modern Memorial Art." Write for your copy.

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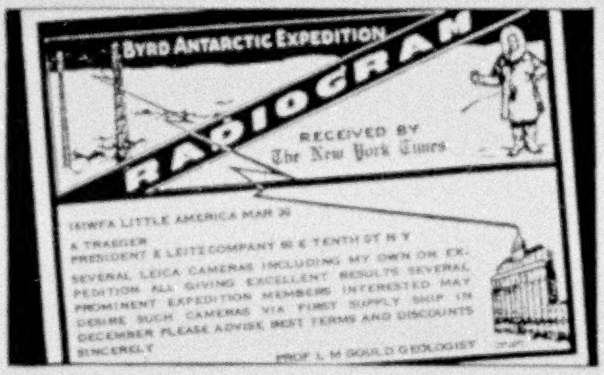
Above Names Protected by Trade Mark



BYRD ANTARCTIC EXPEDITION
RADIOGRAM
RECEIVED BY
The New York Times

161WFA LITTLE AMERICA MAR 30
A TRAEGER
PRESIDENT E LEITZ COMPANY 60 E TENTH ST N Y
SEVERAL LEICA CAMERAS INCLUDING MY OWN ON EXPEDITION ALL GIVING EXCELLENT RESULTS SEVERAL PROMINENT EXPEDITION MEMBERS INTERESTED MAY DESIRE SUCH CAMERAS VIA FIRST SUPPLY SHIP IN DECEMBER PLEASE ADVISE BEST TERMS AND DISCOUNTS
SINCERELY
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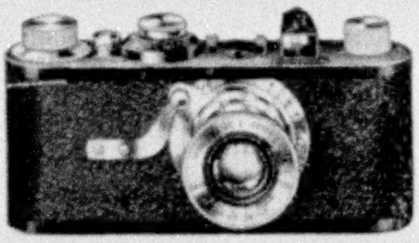

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This charming Dutch Colonial cottage near Baltimore will never need another roof because it is covered with fireproof J-M Asbestos Shingles.

Will your roof *burn*—or will it *not?*

There is no safe middle ground

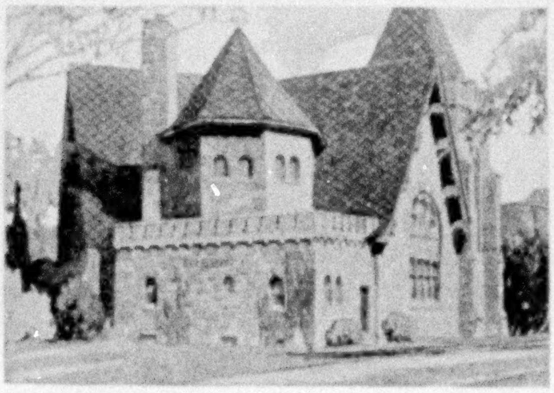
DURING the past year approximately 23 per cent of all residential fires in the United States started on *roofs!* And only one thing will keep your home safe from roof-communicated fires, from the hazard of flying firebrands—*a fireproof roof.*

Johns-Manville Rigid Asbestos Shingles *cannot burn.* They are made of asbestos fibre and Portland Cement, perfectly united, under tremendous pressure. With these shingles on your home—the fire hazard is ended forever. A J-M Roof *cannot burn.*

J-M Asbestos Shingles can be heated white-hot without injury—a test which would destroy other roofings. This reserve of strength, this marvelous independence of fire means everlasting protection for the home roofed with J-M Shingles. Unharmed by extremes of heat or cold, by rain, sleet or snow, you are guarded by a roof which will outlast your house itself. Recent scientific tests prove that weather actually makes J-M Asbestos Shingles tougher and stronger!

This is the age of color—and the wide range of colors and color combinations available in Johns-Manville Asbestos Shingles make possible any effect you may desire. Whatever the type of house, there is a J-M Roof to complete its beauty. And best of all—this permanent protection and colorful beauty is not accompanied by high price. For example, a roof of J-M No. 70 Mottled Gray Asbestos Shingles costs only approximately 12% more than a roof of 18-inch Stained Cedar Shingles. In the long run, a J-M Asbestos Shingle Roof is the least expensive of all roofs. The first cost is the last cost. No maintenance or repair bills. *You roof or re-roof for the last time.*

Every J-M Asbestos Shingle Roof is accompanied by a "certificate of registration." It will assure you that your roof is of Johns-Manville manufacture—everlastingly beautiful—eternally fireproof. Fill out the coupon today, and let us arrange for a free inspection of your roof—and an estimate (without obligation) for re-roofing with J-M Shingles.



How perfectly this attractive roof of J-M Mottled Gray Hexagonal Asbestos Shingles blends with the architecture of this Toledo, Ohio, Church. Schools, institutions, churches—as well as residences find permanent roofing beauty and protection in J-M Shingles.

The Master Product of a Famous Manufacturer

J-M Asbestos Shingles are a master product of Johns-Manville—the world's leading manufacturer of fireproof, permanent roofing and building materials.

Johns-Manville

RIGID ASBESTOS SHINGLES

JOHNS-MANVILLE CORPORATION
New York Chicago Cleveland San Francisco Toronto
(Mail coupon to branch nearest you)

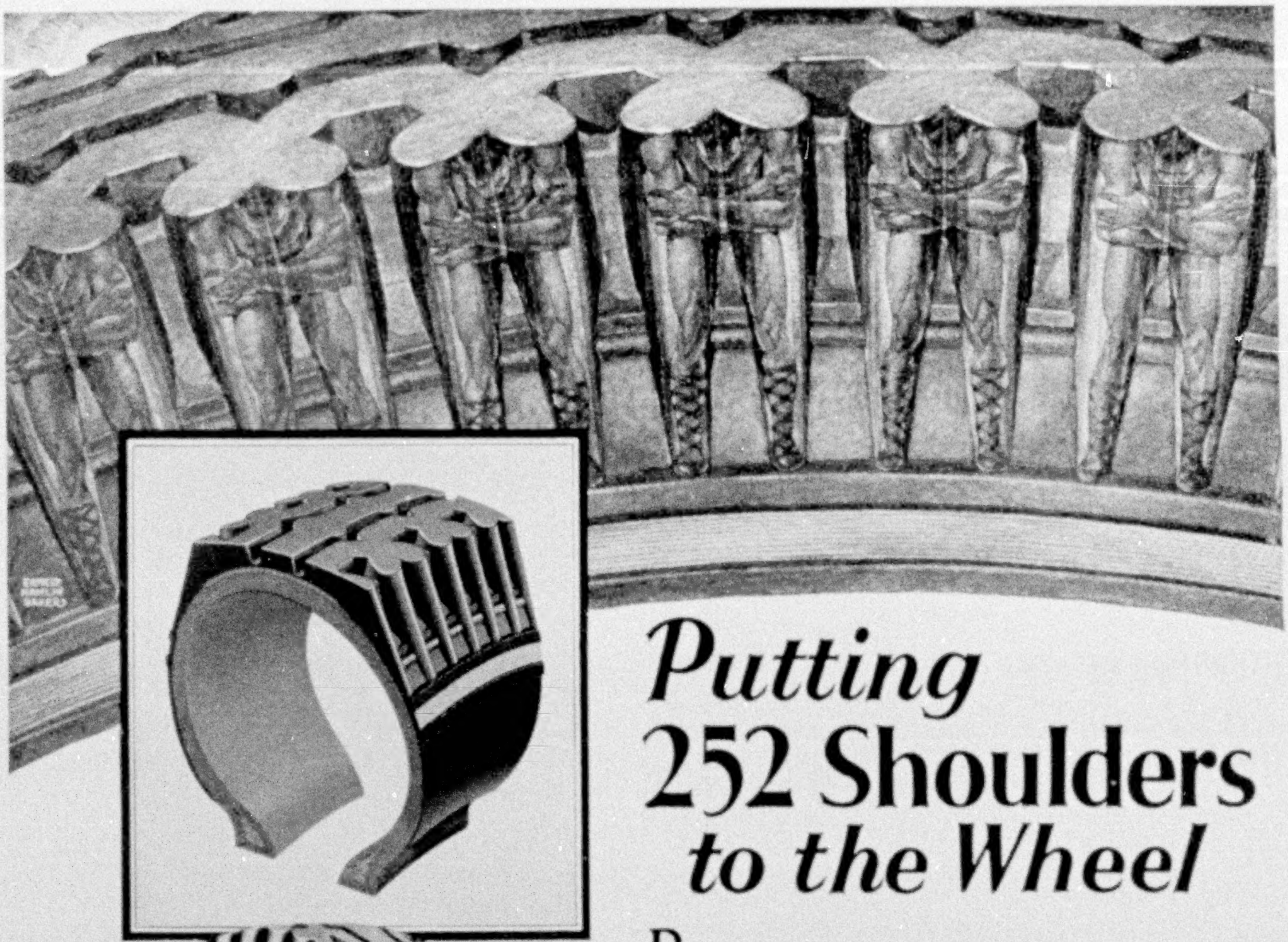
☐ I would be interested in a free inspection of my roof and an estimate on re-roofing costs.

☐ Please send free copy of "The *New* Book of Roofs."

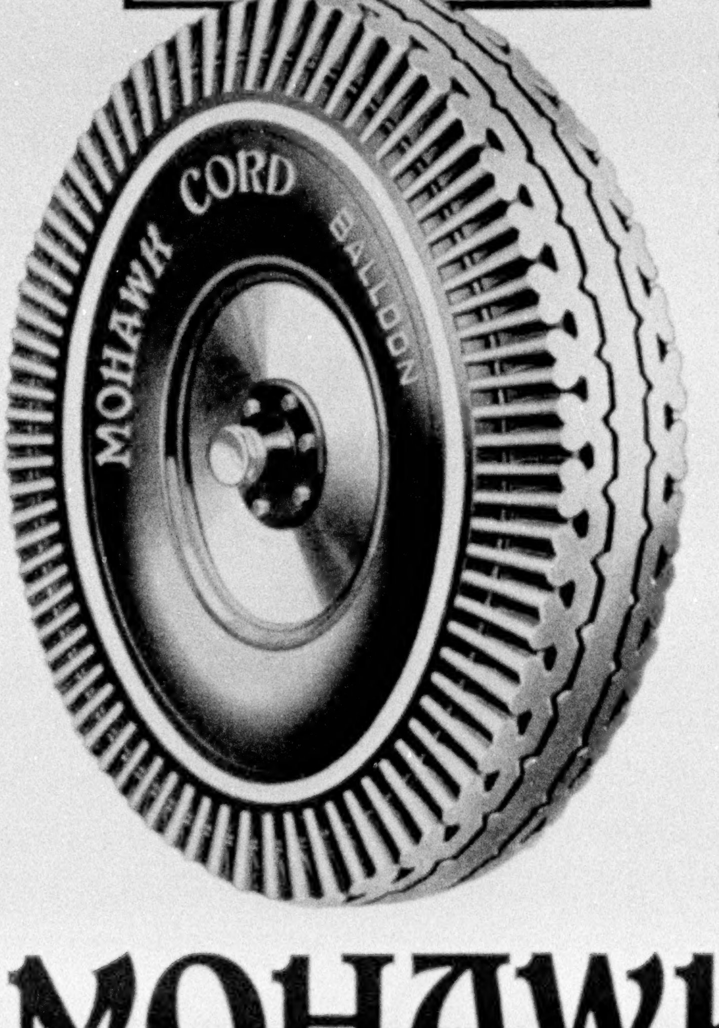
Name..

RS-41-7

Address..



Putting 252 Shoulders to the Wheel



BOUNCE a weight on a strong man's shoulders. How does he take the shock? By flexing the knees. That's the theory of the Mohawk Flat Tread Special Balloon. 252 broad shoulders take the brunt of the blows. 252 massive buttresses carry the shocks to the "knees" of the tire — the 6-ply walls that are built for flexing. This scientifically correct tire grips the road, spreads the load, saves the tread, absorbs the shocks . . . requires 15% lower air pressure, which immensely increases traction and riding ease. Look for the buttressed shoulders, the distinguishing mark of a distinguished tire.

Featured by Quality Tire Dealers Everywhere

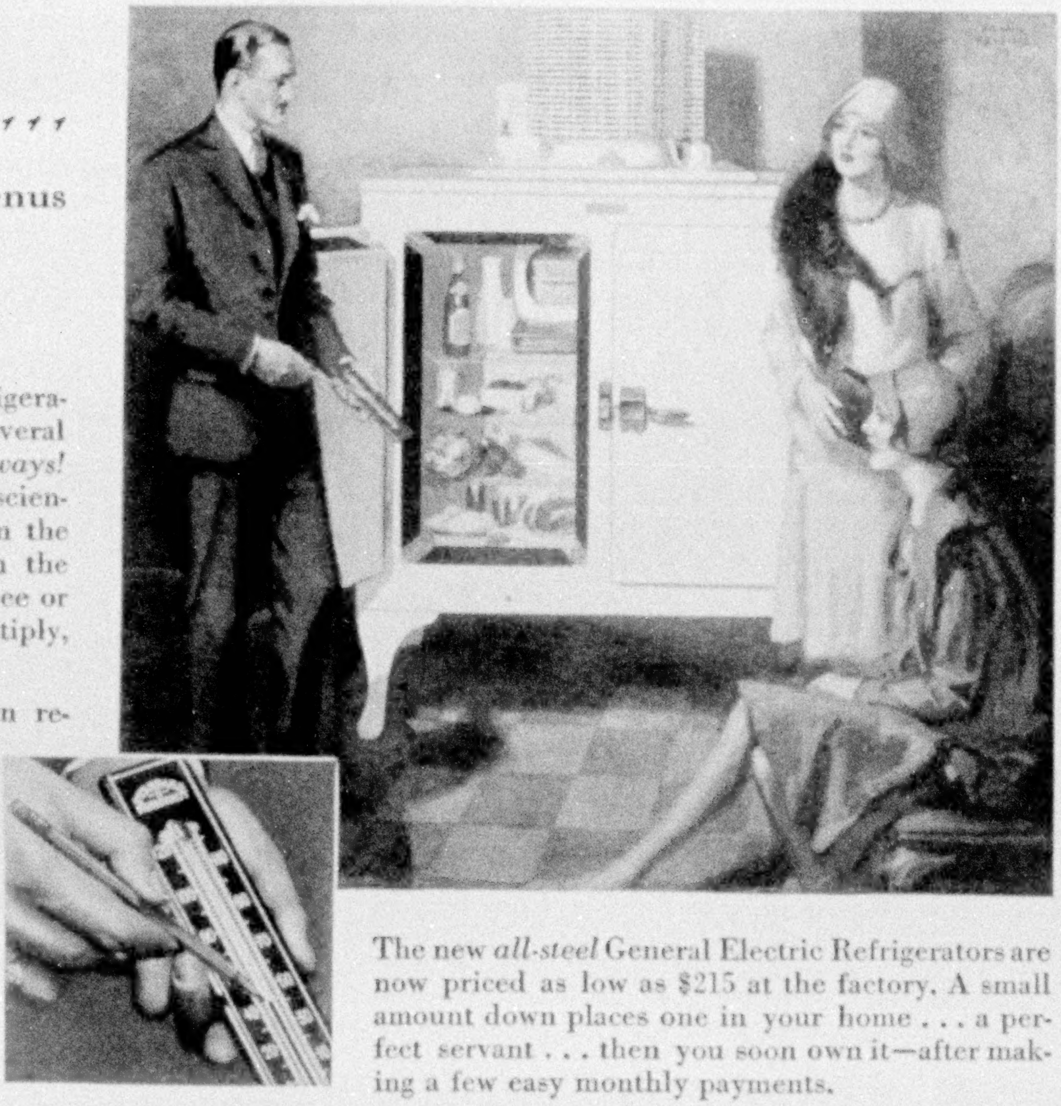
MOHAWKS GO Farther!

THE MOHAWK RUBBER COMPANY . . . AKRON, OHIO

For Sixteen Years Makers of Fine Tires

It keeps your food safe
—the temperature is well below 50°…always!

For family health ▸ ▸ ▸
for appealing menus
▸ ▸ ▸ this is vital



In the General Electric Refrigerator the temperature is kept several degrees below fifty . . . *always!* Fifty degrees is accepted by scientists as the "danger point" in the preservation of food. When the temperature rises even a degree or two above that, bacteria multiply, foods become unsafe.

Perhaps you think your own refrigerator is always "cold enough." You cannot be *sure* unless you actually take your refrigerator's temperature. It is *constant* cold which is needed. When you own a General Electric Refrigerator, you need never worry.

Note these vital points of superiority

Countless superiorities give the General Electric Refrigerator its outstanding position . . . an hermetically sealed, dust-proof mechanism, mounted on top . . . an accessible temperature control . . . a new standard of quiet operation . . . no oiling . . . no troublesome machinery . . . simplified installation . . . no radio interference . . . an unqualified two-year service guarantee.

Now, in addition to all these proved electrical and mechanical superiorities, General Electric offers the latest advancement . . . an *all-steel* cabinet! Beautiful. Non-warping. Strong as a safe. The new *all-steel* cabinet and the hermetically sealed mechanism combine to produce what we believe is the finest refrigerator ever made.

Mass production brings greater savings for the public. The new *all-steel* General Electric Refrigerators are now priced as low as $215 at the factory. A small amount down places one in your home . . . a perfect servant . . . then you soon own it—after making a few easy monthly payments.

Visit the nearest General Electric Dealer—see these new models—you'll agree that they offer the greatest values of all . . . and any comparison will surely confirm your judgment. Or if you prefer, you may obtain the whole story of *safe* refrigeration by writing Electric Refrigeration Department of General Electric Company, Hanna Building, Cleveland, Ohio, for Booklet R-7.

Not a dollar for repairs

More than a quarter of a million homes are enjoying the convenience, economy and health-guarding services of the General Electric Refrigerator. And not one of these owners has ever paid a dollar for repairs or service . . . that was our guarantee to them! It's a record in the industry.

GENERAL ELECTRIC

ALL-STEEL REFRIGERATOR

Homeric days

Mediterranean
Cruise Supreme

from New York January 25th, next

In the wake of Ulysses! The "Ship of Splendor", *Homeric*—one of the World's foremost ships—the largest steamer to the Mediterranean—14,000 miles in 65 Spring days. Lands poignant with memories of Moses, Mohammed, Alexander and Caesar, Hannibal and Napoleon . . . lands of the bournous, the veil and the volcano . . . of gem-like cities on history-etched shores. *The unusual*—to the unfrequented isles of Majorca, Malta, Corsica and Cyprus . . . the fascinating cities of Casablanca and Barcelona . . . with happy days in Madeira, Gibraltar, Algiers, Monaco, Naples, Sicily, Greece, Turkey—two weeks in Egypt—the Holy Land. Generous stay-over privileges. Returning via England on the Majestic, Olympic or Homeric.

Full particulars upon request

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THEY'RE OFF!

There they go streaking down the track! Follow your favorite with a Zeiss — watch him nosing ahead — thrill to the "close-up" as he comes thundering under the wire to victory! Ask your dealer to show you a Zeiss, or write for catalogue.

Carl Zeiss, Inc., 485 Fifth Ave., New York
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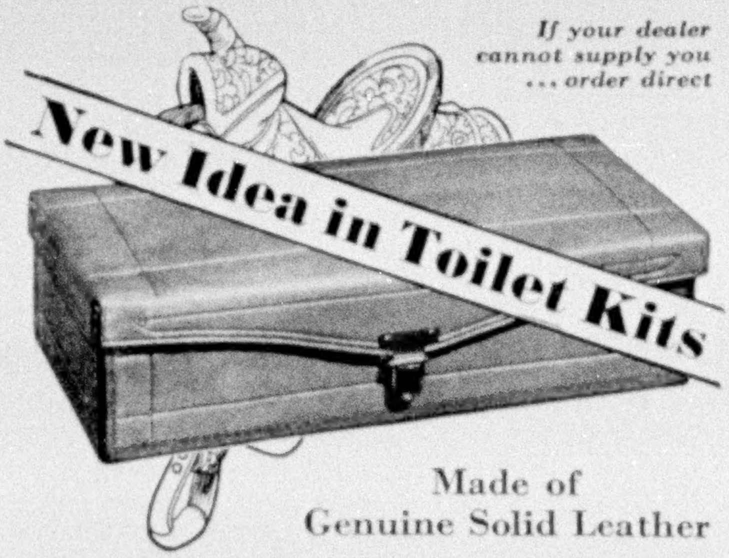
ZEISS
BINOCULARS

CARL ZEISS JENA

If your dealer cannot supply you . . . order direct


New Idea in Toilet Kits

Made of
Genuine Solid Leather

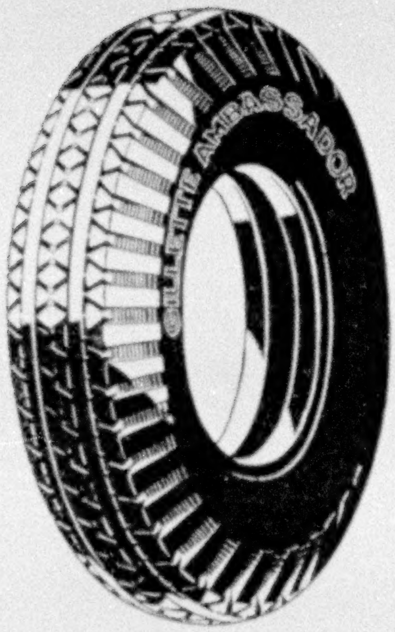
HERE'S the handiest, best-looking toilet case you ever saw. A simple solid-leather box, *minus* the tricky loops and gadgets and cubby-holes which waste time and patience. You just toss toilet articles in. No packing at all . . . everything *fits*. Made of choice, thick, solid leather in natural russet color. Sewed with heavy waxed saddlethread, with corners back-stitched by hand and guaranteed not to rip. Special imported clasp. Sent postpaid. If you do not like it, we cheerfully refund your money! Hamley & Co., Saddle Makers, 245 Court St., Pendleton, Ore., U. S. A.

The HAMLEY KIT

Medium	(8⅝ x 3⅞ x 1⅞)	$ 6.00
Large	(9½ x 4½ x 2¼)	7.50
Extra Large	(10½ x 5⅜ x 2¾)	10.00

Name or initials embossed on lid, 25c extra

THE GILLETTE *AMBASSADOR* TO THE TIRE WORLD ▲ ▲



THE GILLETTE Ambassador is truly a super tire—designed for those who are satisfied with nothing short of the best in design, construction and materials.

Only select, long staple Egyptian cotton is used for its cords—six plies. Each layer floats in rubber of purest gum—firmly embedded and completely cushioned to prevent internal friction. 100 per cent more rubber is used, giving this six-ply tire all the resiliency and flexibility of a four-ply. Sturdier treads of special design and unusual thickness give still further protection.

The Ambassador is built to outlast your car. Ask any Gillette dealer to show you the Ambassador.

GILLETTE RUBBER CO., Eau Claire, Wis.

A BEAR FOR WEAR

RADIO

Tune in on Station WTAQ (1330 Kilocycles) owned and operated by the Gillette Rubber Co., Eau Claire, Wis. Educational and entertaining programs including the popular Gillette Bears.

N-3-29

Gillette
TIRES AND TUBES

PALMOLIVE
Shaving
Cream
Wait
to Buy

Make this FREE 7-day test first to prove to yourself the supremacy of this unique shaving cream. Mail coupon.

GENTLEMEN:

We have sold more shaving cream by telling men *not* to buy it than many have sold who constantly urge its purchase.

Instead we have urged "Don't buy yet—first let us prove to you the merits of our case, *at our expense.*" And that confidence and the superiorities of our product have won 86% of the men who have made our test.

The coupon is for your convenience. It brings a liberal tube—at our expense. Use it seven days. Then, if convinced of what we claim, you will want to buy. Many men who never clipped an advertising coupon before in their lives are now the greatest boosters of Palmolive Shaving Cream.

5 unique advantages

1000 men were asked what they sought in a shaving preparation. With their specifications, our huge laboratories began. After 129 experiments, success came.

These are the five things we achieved, all in one noteworthy shaving cream:

1: Multiplies itself in lather 250 times.
2: Softens the beard in one minute.
3: Maintains its creamy fullness for 10 minutes on the face.
4: Strong bubbles hold the hairs erect for cutting.
5: Fine after-effects due to palm and olive oil content.

Please make the test

You may be happy with your present shaving preparation, still find this one better. You risk nothing in trying. *We* take the chance. So won't you mail the coupon, please?

PALMOLIVE RADIO HOUR—Broadcast every Wednesday night—from 9:30 to 10:30 p. m., eastern time; 8:30 to 9:30 p. m., central time; 7:30 to 8:30 p. m., mountain time; 6:30 to 7:30 p. m., Pacific time—over station WEAF and 37 stations associated with The National Broadcasting Co.

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Try the sample we are sending free with the tube of Shaving Cream.

7 SHAVES FREE

and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-3085, Palmolive, 595 Fifth Ave., New York City. In Canada, address Palmolive, Toronto 8, Ont.

....

....

....

(Please print your name and address)

New Lands for Pleasure Travelers

Peru with its Inca ruins—Bolivia in the Andes—Chile—the winding Straits of Magellan—the Argentine Republic and Buenos Aires—the Oriental Republic of Uruguay—Santos, the world's chief coffee port—Rio de Janeiro and historic Bahia

RAYMOND-WHITCOMB

Round South America ✣ Cruise ✣

¶ Sailing February 1, 1930, for a two months' voyage completely round the great southern continent, with visits to its chief cities and its characteristic sections. On the S. S. "Samaria." The Cruise will be limited to 280 members, and only staterooms with outside windows will be used. Rates, $1250 up.

Send for the Booklet—"ROUND SOUTH AMERICA"

ROUND THE WORLD CRUISE

¶ On the S. S. "Columbus," largest and fastest liner ever to sail round the world. With less time at sea than any other round the world cruise, yet unusually complete in its program of calls, excursions and sight-seeing. Sailing January 21, 1930.

MEDITERRANEAN CRUISE

¶ More complete than ever before—with calls in Albania, and Rhodes, in addition to all the usual calls in Europe, Asia Minor, and North Africa. Sailing January 23, 1930, on the S. S. "Carinthia."

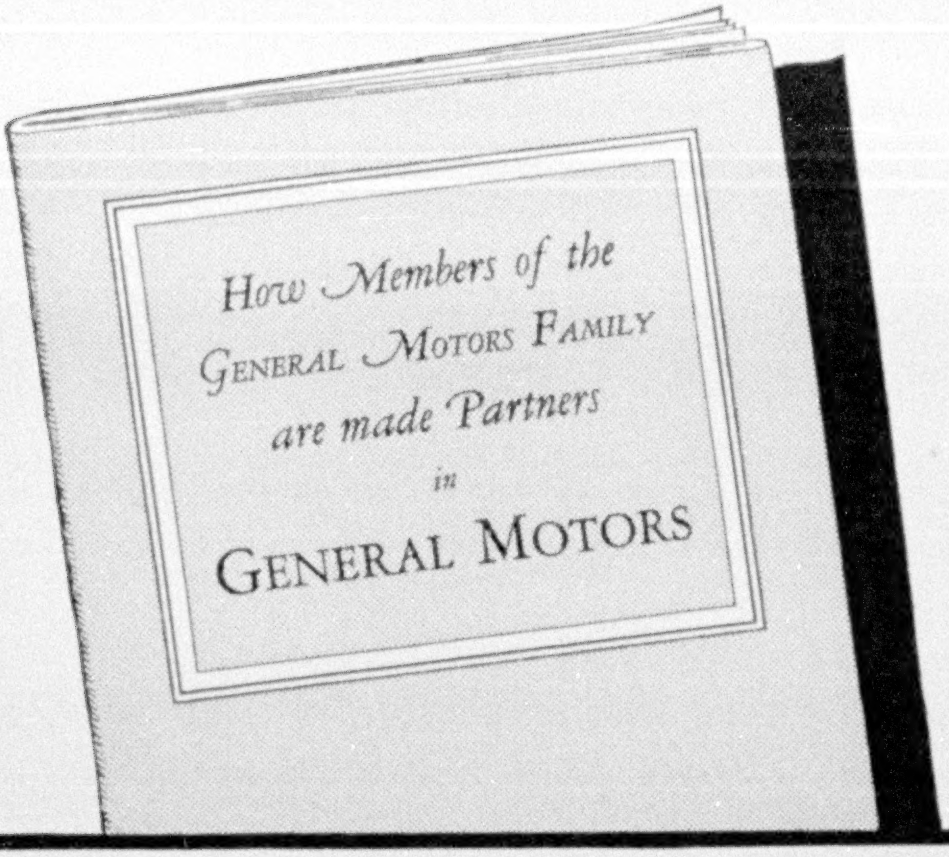
West Indies Cruises

RAYMOND-WHITCOMB

126 Newbury Street, Boston, Mass.

New York, 606 Fifth Avenue; New York, 225 Fifth Avenue.
Boston, 165 Tremont Street; Philadelphia, 1601 Walnut St.
Chicago, 176 N. Michigan Ave.; Detroit, 421 Book Bldg.
Los Angeles, 423 West Fifth St.; San Francisco, 230 Post St.

Agents in the principal cities



GENERAL MOTORS believes that employees in the plant, as well as executive officers, should have the opportunity to become stockholders, and thereby partners in the enterprise to the success of which they are contributing. Alfred P. Sloan, Jr., President of General Motors, has said on the subject:

"The prosperity that General Motors has enjoyed, naturally cannot be attributed to any single influence, but on the contrary has resulted from the combined effort of many. The degree to which any institution permanently succeeds is tremendously influenced by the ability with which capital, labor and the management are co-ordinated in serving the public. . . . Broadly speaking, I firmly believe that General Motors in the execution of these policies has justified itself not only as an economic and efficient instrument for the production and sale of merchandise, but in its public and industrial relations as well."

The booklet, describing how members of the General Motors family are made partners, will be mailed free upon request to Department K-7, General Motors Corporation, Broadway at 57th St., New York.

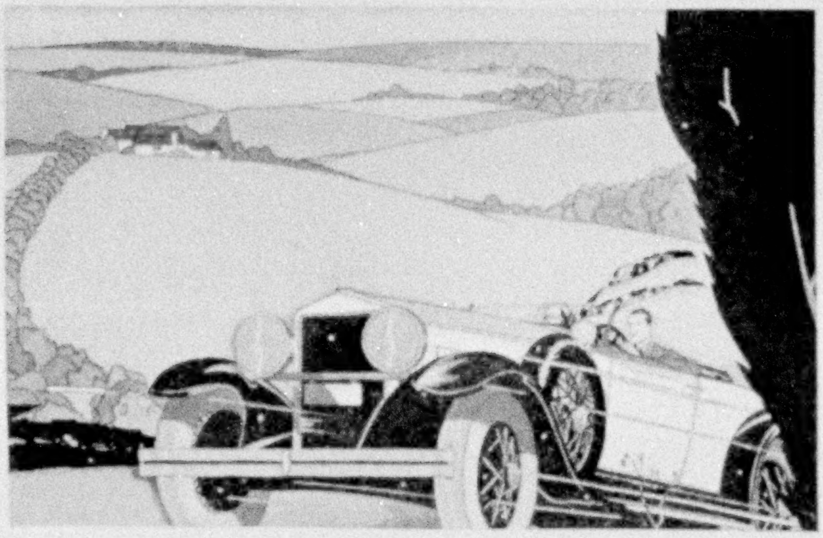
GENERAL MOTORS

"A car for every purse and purpose"

CHEVROLET · PONTIAC · OLDSMOBILE · MARQUETTE · OAKLAND
VIKING · BUICK · LaSALLE · CADILLAC · *All with Body by Fisher*
GENERAL MOTORS TRUCKS · YELLOW CABS *and* COACHES

FRIGIDAIRE—*The Automatic Refrigerator* · DELCO-LIGHT *Electric Power and Light Plants* · DP *Water Systems* · GMAC *Plan of Credit Purchase*

Money Protection *for your Summer Play-days*



PREPARING for your vacation or auto trip? Engine in tune? Tires in good shape? How about the money that must be taken along? How about funds for emergencies? Your money needs protection—as much as your car does. Carrying cash is dangerous. Personal checks are not readily accepted where you are unknown. Loose bills can be mislaid or pilfered, and if you *lose* your bankroll, what chance have you of recovering it? ¶ Wise travelers solved these problems long ago by changing their money into American Express Travelers Cheques. Ready for immediate use—spendable everywhere—these cheques carry ironclad protection against theft or loss. You merely sign them once when you buy them. You sign them again when you wish to spend them, not before. They are YOUR individual money which no one but you can use. If lost or stolen, uncountersigned, or not exchanged for value, your money is refunded in full. ¶ *Issued in denominations of $10, $20, $50, $100. Cost 75c for each $100.* ¶ For sale at 22,000 Banks, American Express and Railway Express Agency Offices. Ask for the sky-blue American Express Travelers Cheques.

for safety and spendability

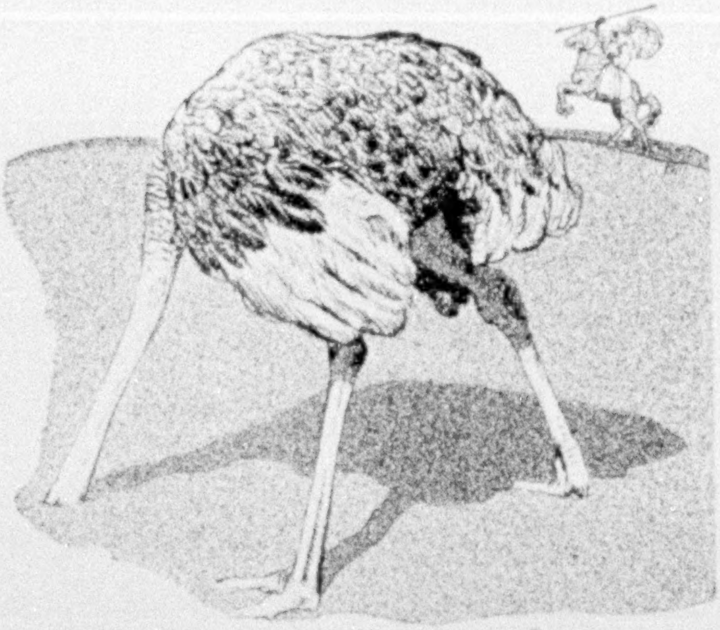
AMERICAN EXPRESS

Travelers cheques

Steamship tickets, hotel reservations, itineraries, cruises and tours planned and booked to any part of the world by the American Express Travel Department

Cancer—Ostriches

THE old notion that ostriches have the habit of hiding their heads in the sand in time of danger has been disproved again and again. Nevertheless the expression "hiding his head in the sand like an ostrich" aptly describes the man who seeks to avoid danger by refusing to recognize it when it comes.



EACH year thousands of people die of cancer—needlessly—because they accept as true some of the mistaken beliefs about this disease.

No. 1—That every case of cancer is hopeless. *It is not.*

No. 2—That cancer should be concealed because it results from a blood taint and is disgraceful. *It is not.*

No. 3—That nature can conquer a malignant cancer unaided. *It can not.*

No. 4—That cancer can be cured with medicine, with a serum or with some secret procedure. *It can not.*

Many cancer patients are neglected or avoided because of the mistaken belief that cancer is contagious. *It is not.*

Be on Watch for First Signs of Cancer

Be suspicious of all abnormal lumps or swellings or sores that refuse to heal, or unusual discharges from any part of the body. Do not neglect any strange growth. Look out for moles, old scars, birthmarks or warts that change in shape, appearance or size.

If you have jagged or broken teeth, have them smoothed off or removed. Continued irritation of the tongue or any other part of the body is often the beginning of cancer trouble.

In its early stages, various kinds of cancer yield to skilful use of surgery, radium or x-rays. But the best doctors in the world are powerless unless their aid is sought in time.

Beware of Plausible Quacks

THE LIGHT THAT NEVER FAILS

Because the nature and origin of cancer are largely shrouded in mystery, quacks and crooked institutions reap a cruel harvest. They prey upon the fear and ignorance of those who do not know the facts concerning cancer. They are often successful in making people believe that they have cancer when they have not. Later, with a great flourish, they boast of their "cures".

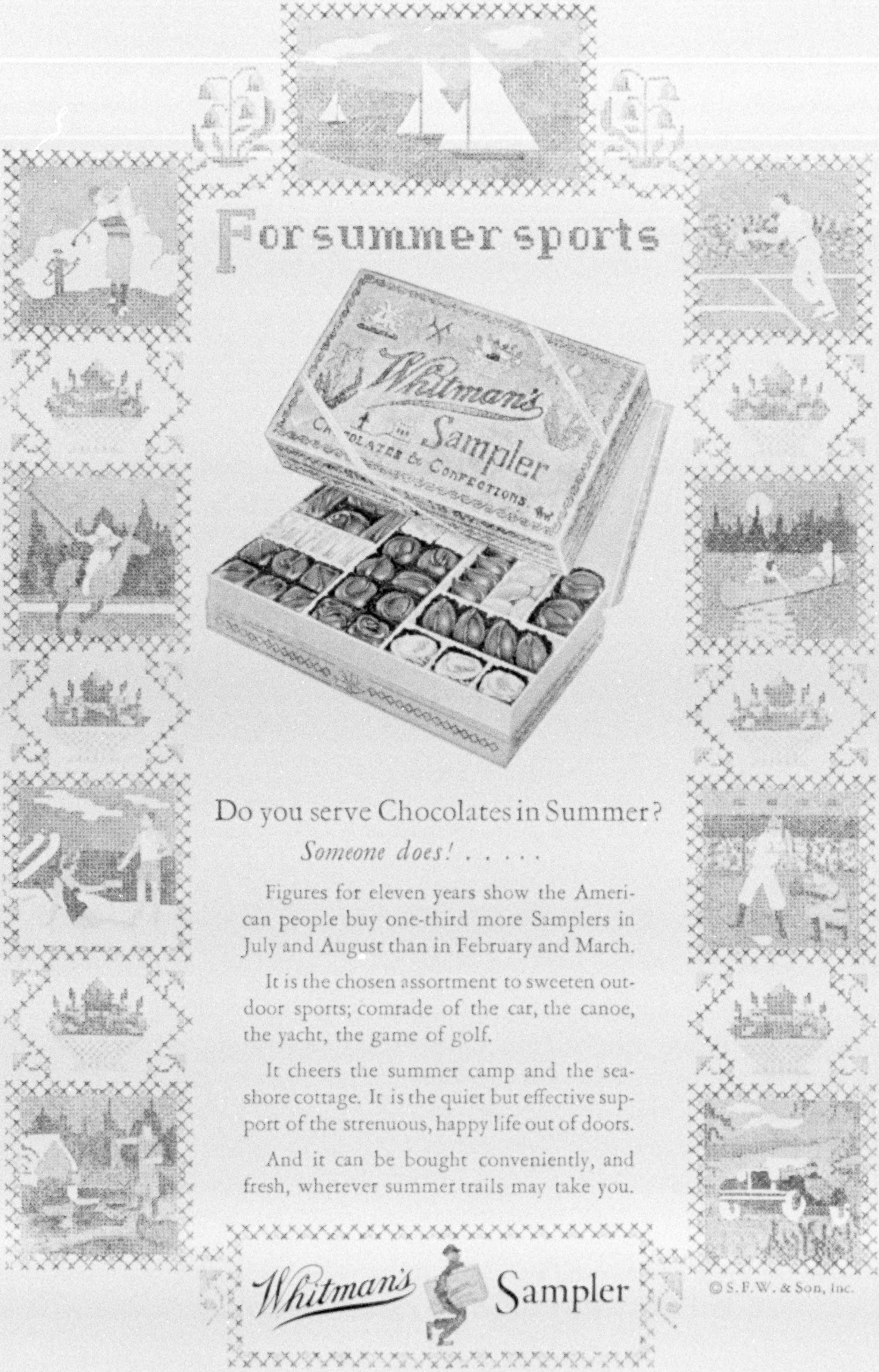
Gratefully the patients of the fakers, first thoroughly alarmed, later entirely reassured, are glad to sign testimonials with which new victims are trapped. Beware of those who advertise cancer cures.

An annual physical examination by your family physician, or the expert to whom he sends you, may be the means of detecting cancer in its early stages. Do not neglect it.

Send for the Metropolitan's booklet, "A Message of Hope". Address Booklet Department, 79-N, Metropolitan Life Insurance Company, New York.

METROPOLITAN LIFE INSURANCE COMPANY—NEW YORK

Biggest in the World, More Assets, More Policyholders, More Insurance in force, More new Insurance each year



For summer sports

Do you serve Chocolates in Summer?

Someone does! . . . . .

Figures for eleven years show the American people buy one-third more Samplers in July and August than in February and March.

It is the chosen assortment to sweeten outdoor sports; comrade of the car, the canoe, the yacht, the game of golf.

It cheers the summer camp and the seashore cottage. It is the quiet but effective support of the strenuous, happy life out of doors.

And it can be bought conveniently, and fresh, wherever summer trails may take you.

Whitman's Sampler

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VOL. LVI, No. 1 WASHINGTON JULY, 1929

THE NATIONAL GEOGRAPHIC MAGAZINE

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EXPLORING THE WONDERS OF THE INSECT WORLD

By William Joseph Showalter

Author of "Exploring the Glories of the Firmament," "Exploring the Mysteries of Plant Life," etc., etc., in the National Geographic Magazine

THOUGH intrepid explorers have conquered the earth's opposite poles, climbed its highest mountains, crossed its most dangerous deserts, penetrated its deepest jungles, and sounded its most profound seas, fortunately they have left many realms closer home and less challenging to human endurance where the humblest of us can lead expeditions and from which the poorest of us may bring back rich trophies of new knowledge.

Insectdom is one of these near-by realms that offers rare rewards to those whose eyes are alert, whose minds are keen, and whose patience is unrelenting. It begins in our own dooryards and stretches as far afield as we choose to wander. The man, or woman, or child who turns explorer there will find among its tiny folk more occasions to marvel than Gulliver in all his travels, more reasons to wonder than the fabled adventurer into the topsy-turvy territories of the Kosekins.

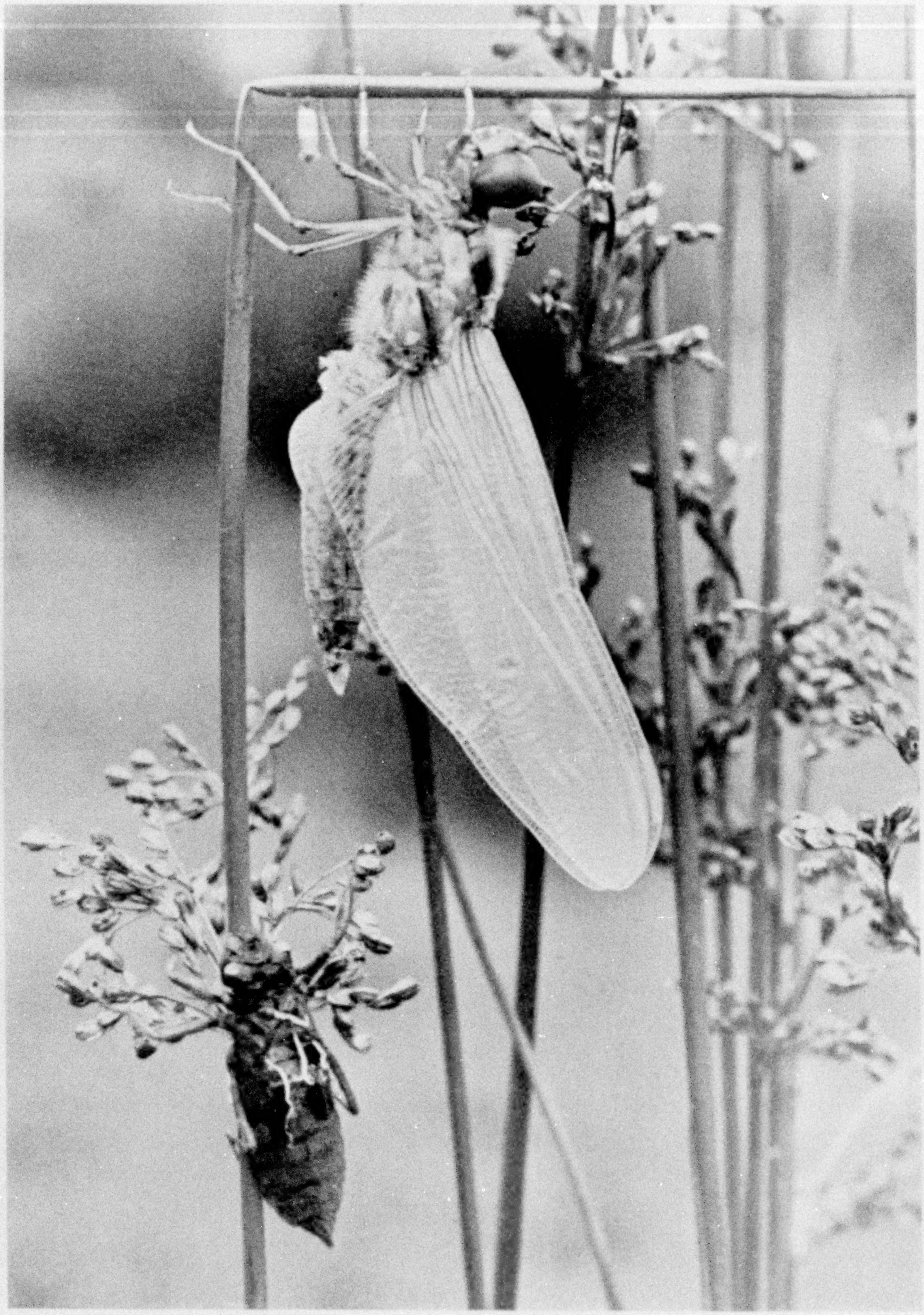
For among the insects one finds habits of life that run the gamut of interest, from the amazing to the bizarre; discovers traits that in some ways seem to transcend human intelligence; beholds untaught powers of foresight that appear to outshine man's most highly trained faculty of taking thought of the future; sees intricate chemical and physical problems solved in a manner worthy of our finest laboratories; gets glimpses of natural powers of perception that go far beyond our unaided senses and rival the detecting powers of the finest instruments that science has brought to the student's aid. One even runs upon solutions of involved social problems that civilization has tried vainly to master.

INSECT FORERUNNERS OF MODERN INVENTORS

Into this wonder world many explorers have gone who could match the intrepid courage of a pole-seeker with the unconquerable patience of a life-history hunter. Whoever reads Fabre and Forel, Comstock and Kellogg, Lutz and Wheeler, the Peckhams and the Raus, and scores of others knows alike what infinite treasures of truth already have been gathered and what bonanzas of interest still lie untouched.

Through such workers as these we have learned that long before our ancestors had emerged from their primeval caves, or had dreamed of a better anesthetic than a club, the glowworm had evolved a sleeping potion so subtle that its victim could not perceive its administration, yet so powerful that nothing could disturb the profound sleep it induced.

When our forbears were dressing in skins and before they had domesticated even the dog, the bagworms, larvæ of the Psyche moths, were tailoring themselves snug coats and close-fitting nightcaps,



© Lynwood M. Chace

A DRAGON-FLY THAT HAS JUST EMERGED FROM ITS NYMPHAL STAGE

This gauzy-winged creature has just transformed itself from a nymph, such as is shown in the lower left corner of the picture. It will cling to the grass stem until the chitin of its body hardens and until the fluid that flows through the hollows of the struts forming the framework of its wings crystallizes. Then it will be ready to fly away, one of the swiftest of all the insect clan.

while the ants were keeping "cows" and growing "mushrooms" (pages 16, 17).

Before primeval man had learned to kindle his first fire or dreamed of the use of coal, the social bees were employing in hive ventilation the identical principles that industry now uses in keeping pure air in modern coal mines.

While our race was still without the slightest understanding of the functions of the nervous system, some of the wasps had learned to paralyze their prey and to classify insects according to the unity or multiplicity of their ganglia.

Far antedating man's earliest employment of the principles of cold storage and sterile preserving, the wasp was keeping meat fresh for weeks and the bee was storing honey that remained sweet indefinitely.

Long before modern civilization had appeared upon the face of the earth, the caddis-fly's children were building themselves submarines and some species were attacking their victims without warning.

The Eumenes wasp was a finished potter, employing fine natural cements and excellent hydraulic mortars, ten thousand generations before the human artisan knew how to fashion a flint.

The bombardier beetle employed gas against his enemy unnumbered centuries before the oriental invented the stinkpot or man resorted to gas warfare.

AMAZING ADAPTATIONS TO ENVIRONMENT

While man has progressed mainly through the development of the intellect, meeting his problems of existence through the powers of his mind, Nature has helped the insect hosts climb their ladder of achievement by developing their physical adaptations to the requirements of their environment.

For vast ages and countless generations it has been the great Master Breeder sternly, even if so slowly as to make it an almost imperceptible process, weeding out the weaklings and protecting the fit. In this way every physical and instinctual quality that has made an insect more suited to its environment has been further improved.

These processes, employed with such profit by man in the development of qualities that the better meet his needs in flowers, fruits, grains, horses, cattle, dogs, and poultry, have wrought marvelous transformations in the insect, both in body structure and life habit.

Through them the wasp has achieved the poisoned dagger with which to paralyze its prey; the bee has mastered the secret of sex control; the wingless springtail has produced a triggerlike, stiff hair that provides it with powers of locomotion; the adult May-flies of some species have done away with mouths and stomachs because their mature lives are too short to need them; the dragon-flies have come to possess eyes with as many as thirty thousand facets, to furnish the intense vision required in capturing darting, fast-flying prey.

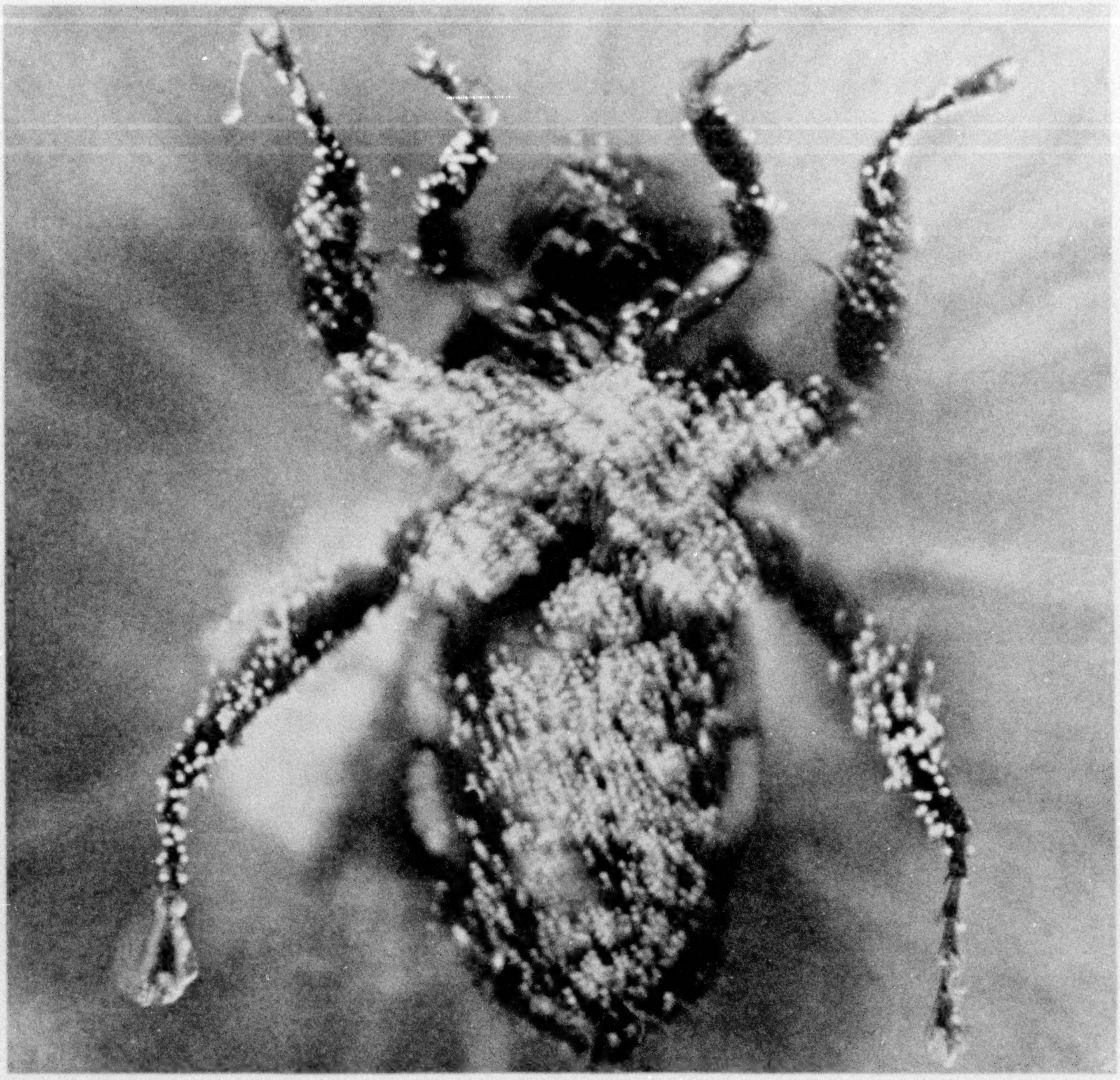
Through these processes, also, the walking sticks have come to look like twigs; butterflies relished by the birds have developed a close resemblance to those the bird's palate detests; certain flies that prefer the precincts of the bumble-bee's nest have copied the bumble-bee's clothes and stature in order to be rated as members of the family rather than as interlopers.

The plant-lice have eliminated males from all but one of their many annual generations, and under laboratory tests have produced 94 generations without the interposition or birth of a single male. The ants bring up heirs apparent to the thrones of their kings and queens, and wood-boring grubs have been known to live forty years in seasoned wood. Carpet-beetles have lived two years in a corked bottle with nothing whatever to eat save the cast-off skins of their own transformations.

THE AGE OF INSECTS

From these fragmentary recitals of some of the ways in which the denizens of the insect world meet their problems of life and solve their enigmas of existence, it is plain that nowhere, either in the fields of fact or fancy, can there be found more surpassing marvels than are to be discovered among the humble folk whom most people dismiss from their minds as mere "bugs."

Man proudly refers to the various epochs of his own history as the Stone



Photograph by Paul Griswold Howes

AN ENLARGED VIEW OF THE UNDER SIDE OF A BUMBLE-BEE, SHOWING HOW POLLEN GRAINS ADHERE TO ITS HAIRS

In visiting the flowers for nectar and pollen out of which to make the paste which it feeds to the larvæ in its nest, the bumble-bee gets a liberal coating of pollen grains. As it passes from flower to flower many of these grains are left on the stigmas, thus fertilizing them. In this way the bumble-bee serves equally well the flowers and the babies of its own household.

Age, the Iron Age, the Age of Electricity, etc.; but, after all, and in terms of epochs immeasurably longer, this is preëminently the Age of Insects. Both in the number of species and of individuals, the insect hosts are the dominant life of the faunal world. As far back as 1907, according to Dr. Frank E. Lutz, more than 384,000 species of them had been described, and the average annual number of new forms found ranges around 6,000. As entomologists penetrate the tropical world more deeply, the annual accretion of new species tends to increase with the passing years.

Estimates of the total number of described and undescribed species range from two to ten millions. Even at the more conservative figure, this would be six times as many as there are of all other animal species combined.

Within a radius represented by a single hour's motor ride, one may find more kinds of insects than there are species of birds in the whole world, and within an hour's walk more kinds than there are species of mammals in all creation.

When the first ambitious creatures of the "bug" world, which bore a rather close

Photograph by Paul Griswold Howes

A SMALL BEE SCRAPES POLLEN FROM ITS FURRY COAT

The coming of such pests as the recently arrived Mediterranean fruit-fly (see pages 10, 11), the European corn-borer, and the Japanese beetle sends shivers of well-founded dread through the American people; but if our bee friends were to leave us *en masse* we would be even more alarmed. Without their pollen-carrying activities most of our flowers and many of our fruits would disappear.

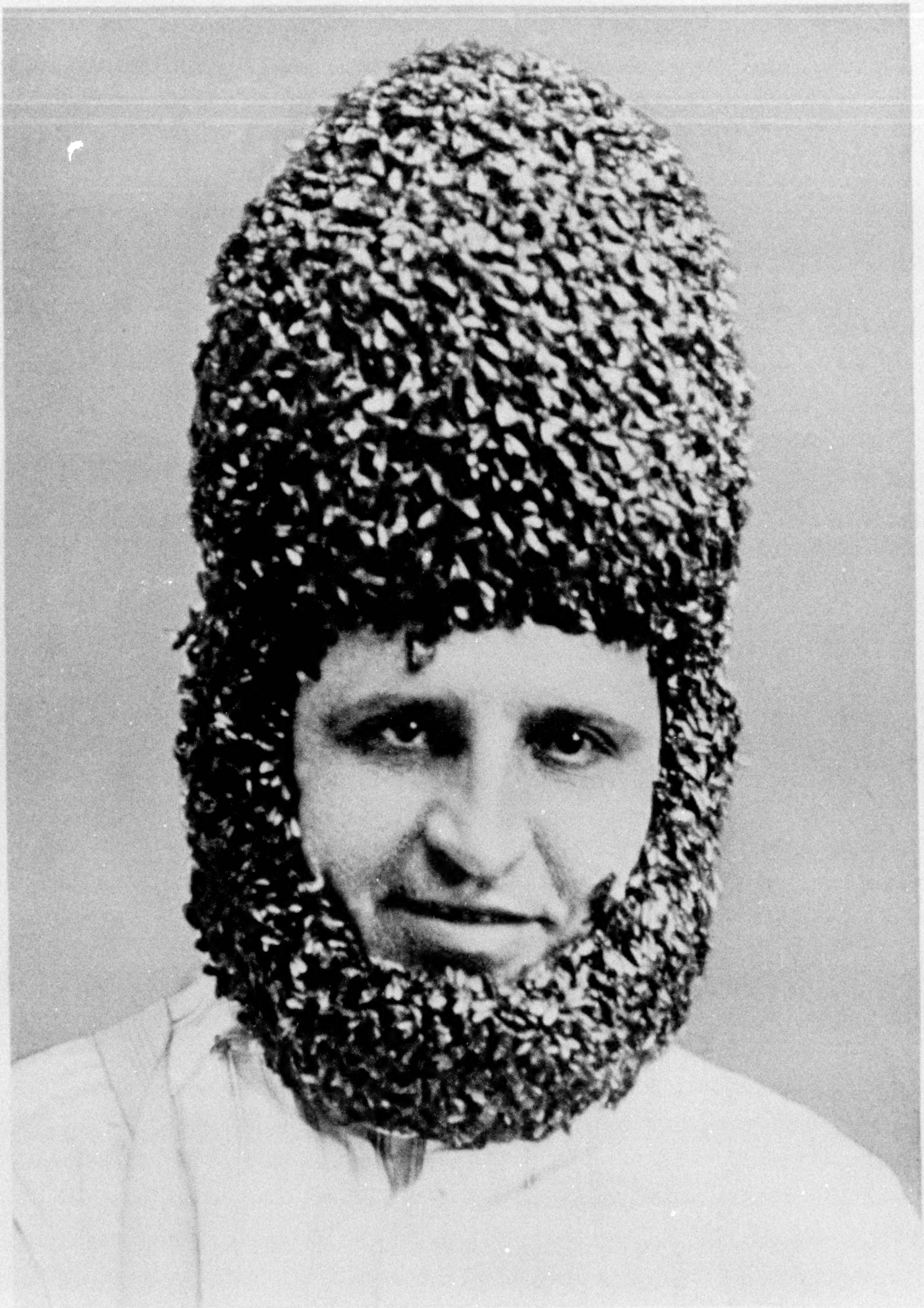
resemblance to our present-day springtails, fish-moths, and silver-fish, began to climb the ladder of winged evolution, releasing themselves from the bondage of feet, they found opportunities for colonization, for multiplication, and for promoting their freedom from enemy attack denied to all creatures limited to legs for locomotion.

AN EONS-LONG STRUGGLE

Chetverikov, the Russian naturalist, describing the trends of early vertebrate and insect life, says that in geological times the vertebrates seemed bent on growing larger, defending themselves in the struggle for survival by accumulating strength. The grass eaters grew larger and stronger, to save themselves from the flesh eaters, and the flesh eaters, in their turn, had to grow stronger and fleeter in order to hold their own in the contest. Finally, both got too big for their environment and both disappeared from the earth, leaving no living species to trace descent from them, and with only their fossil remains persisting to proclaim their one-time existence.

The insects chose another route to survival. With the brevity of life cycle that characterized them, a contest with the vertebrates in size would have been futile; but in smallness they could find a vast number of nooks where they could live in safety, thus filling the chinks and crannies of creation. Just as gravel, then sand and dust, more and more firmly fill the free spaces between the stones in a pile, so the hordes of insects, innumerable as gravel and small as sand, fill the crevices in creation left by the vertebrates.

But even with their smallness the insects of bygone geological ages needed protection. They achieved it by wearing their skeletons on the outside of their bodies and in their wings, and ever since have been growing smaller, although retaining their other major characteristics.



Photograph by Wide World Photos

A HELMET AND CHIN STRAP OF HONEY-BEES

Some strains of honey-bees are mild, sweet-tempered, and gentle; others are nervous, excitable, and cross. Most of them seem instinctively to know who is afraid of them and who is not, and to react to the confidence or fear of those who approach their hives. The Ohio bee-keeper here shown fashioned his dramatic headgear through a gentle and fearless handling of his swarm.

Photograph by Dorothy Smith

A GOOD-SIZED SWARM OF BEES

By the quality of the food given the female larvæ, worker bees determine whether these shall develop into full-sexed queens or whether their reproductive organs shall be so stunted as to make them practically sexless—fellow-worker bees. So well is the royal bee jelly compounded in the hive that even the beekeeper, feeding it to the larva in the cell, can produce a queen at will (see text, page 11).

Back in those remote eras when the earth's vast deposits of coal were still living vegetation, the forest swamps were inhabited by cockroaches longer than a man's finger; dragon-flylike creatures with wing spreads of thirty inches pursued the sluggish prey, and ancestors of our May-flies that were as large as a laborer's hand swarmed around at sunset.

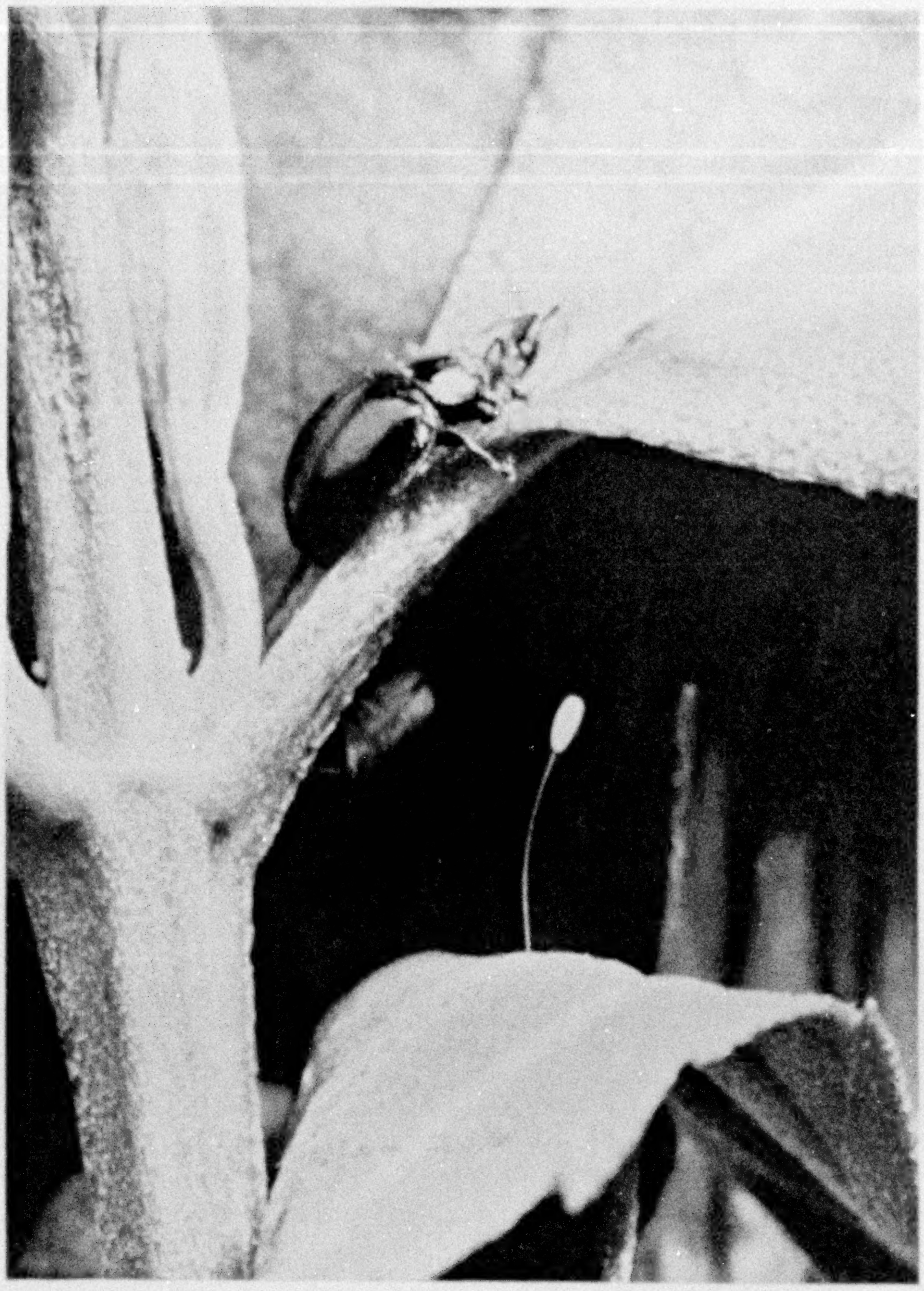
Living on the earth long before man came to take his place in the rôle of one having dominion, the insects will, it is freely predicted by many scientists, still remain long after man has ceased to be a mundane tenant. Dr. W. J. Holland, in his classic work on moths, says:

"When the moon shall have faded out from the sky, and the sun shall shine at noonday a dull cherry-red, and the seas shall be frozen over, and the ice-cap shall have crept downward to the Equator from either Pole, and no keels shall cut the waters, nor wheels turn in mills; when all cities shall have long been dead and crumbled into dust, and all life shall be on the very last verge of extinction on this globe; then, on a bit of lichen, growing on the bald rocks beside the eternal snows of Panama, shall be seated a tiny insect, preening its antennæ in the glow of the worn-out sun, representing the sole survival of animal life on this our earth, a melancholy 'bug'."

Literally true? Certainly not, but a powerful picture of the tenacity of insect life, which was here eons before the first mammal appeared and which probably will be here eons after man's last city shall have been buried beneath the débris of thousands of centuries!

FRIENDS AND FOES OF THE WINGED WORLD

In the furious struggle for survival which is ever raging among the various species of insects, man gains some won-



Photograph by Paul Griswold Howes

A LADY-BIRD BEETLE EATING A PLANT-LOUSE

The plant-lice have eliminated males from all but one of their many annual generations, and under laboratory tests have produced 94 generations without the interposition or birth of a single male (see text, page 3). On the leaf, supported by a hair to keep it out of harm's way, is an egg of a golden-eyed lace-wing fly. The larvæ which emerge from such eggs resemble tiny dragons, and, like the lady-bird beetles and their larvæ, feed upon plant-lice.

derful allies in his own fight for a place in the sun. They prey upon our insect foes as these latter prey upon our food supplies, whether in field or garner, and prevent them from eating us out of house and home.

The Hessian fly, the codling moth, the San José scale, the army cut-worm, the peach-tree borer, the cabbage-caterpillar, the Colorado potato beetle, the Japanese beetle, the Mexican bean beetle, and the apple aphid are only a few examples of the tremendously prolific species that are uninvited and unwelcome "spongers," which insist on being fed before we ourselves can eat.

It is estimated by careful entomologists that only about one per cent of the insect species is directly injurious to man's crops; but these are so greedy and so prolific that the damage they do in the United States alone amounts to more than a billion dollars a year (see illustrations, pages 10 and 11).

The insectean warfare does not end on the battle ground between our enemies and our friends. It is estimated, indeed, that about 50 per cent of all the species are engaged in preying on other insects, including those whose tremendous board bill we have to pay. Watch the wasps provisioning their nests with grasshoppers and caterpillars, or the parasitic flies laying their eggs on cut-worms and in the egg clusters of other enemies; watch the dragon-flies devouring mosquitoes, or the lady-bird beetles combating San José scale, and you will see our faithful friends rendering a vast, even if unconscious, service to humanity.

But the service of our insect friends only begins when they hold our foes in check. Where would be our fruits and our flowers, where our clovers and our vegetables, were it not for the insects that enable them to set seed for our welfare!

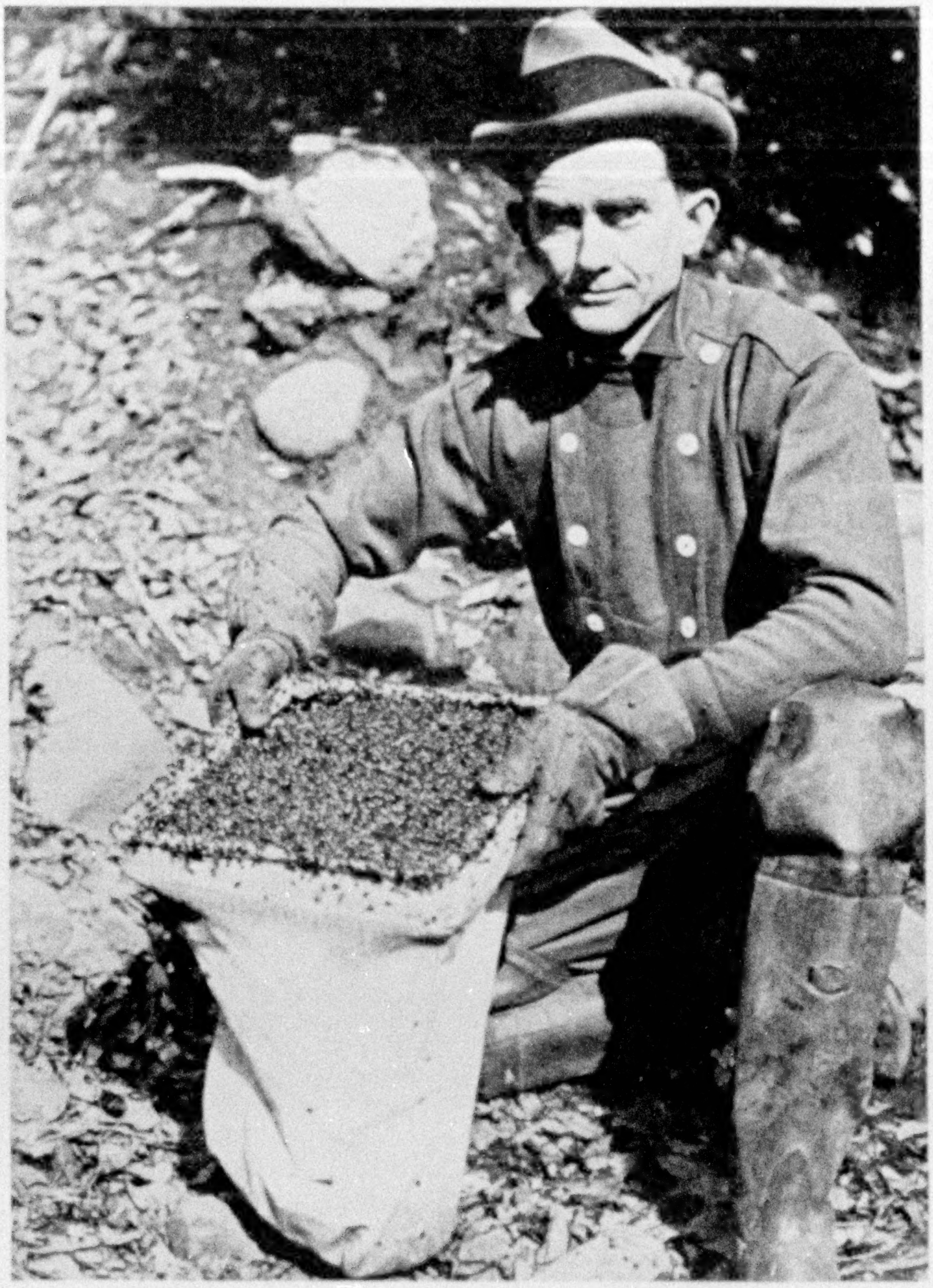
Our fruit crops alone are now worth

some $600,000,000 annually. They would be negligible in quantity and value without the winged messengers that carry pollen from blossom to blossom.

CURIOUS QUIRKS OF THE HUMAN APPETITE

Strange as it may seem, insects and their eggs form favorite articles of diet in many parts of the world.

The Moors fry locusts in butter made from camel's milk, the pupæ of silk-worms are eaten in China, and some species of moths are relished in parts of Africa. Several species of beetles are prized articles of food in Turkey, Moldavia, Wallachia, and elsewhere, while in Nyasaland a paste of May-flies and mosquitoes is eaten with gusto. Some tribes of Mexican Indians, by infusing tiger-beetles in alcohol, make a "hooch" that in the amount of "lightning" it possesses excels any U. S. A. brand of home brew.



Photograph by International

PACKING LADY-BIRD BEETLES IN BAGS FOR SHIPMENT

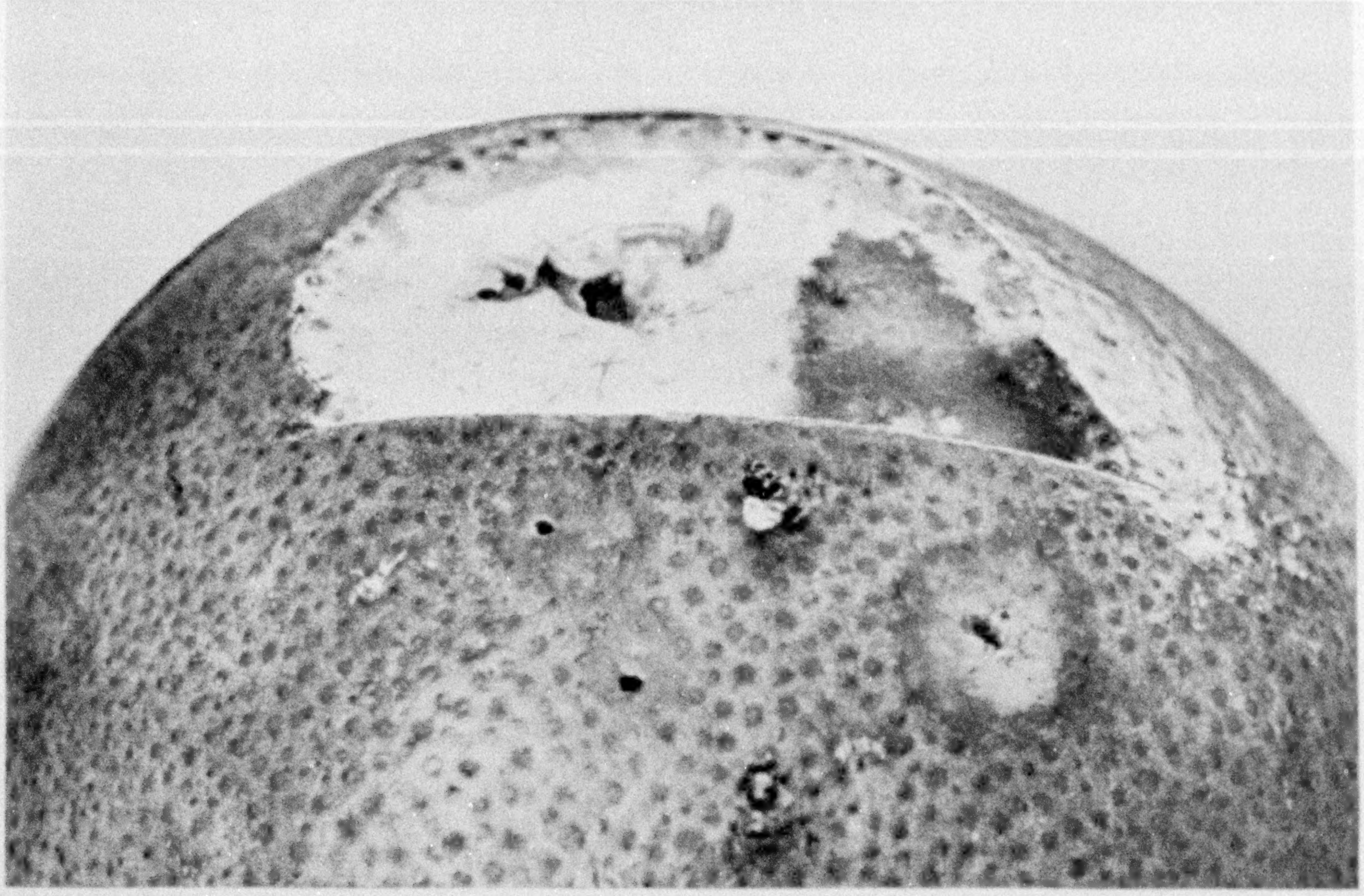
It would be difficult for man to find a better friend among the insects than the lady-bird beetles. They are raised in large quantities and shipped to fruit- and vegetable-growing districts to become allies of man in holding in check scale-insects and plant-lice, which they devour both in larval and adult forms. This shipment is from California.

The insects make important contributions to the world's commerce as well as to regional food supplies. Shellac, which has so many uses, from wax for our floors to stiffening for our derby hats and disk material for our phonographs, is made from lac, the secretion of an Asiatic scale. A beetle known as the Spanish fly is transformed into one of the medical world's principal blistering agents and forms an ingredient of many hair washes.

Tannin and ink are derived from various galls; the cochineal, a scale-insect, is used to make a dye found superior to synthetic dyestuffs for coloring soldiers' uniforms, while the silk-worm is the manufacturer of the world's most prized textile threads, and the bee is maker of one of civilization's most delectable sweets.

THE BODIES OF INSECTS

Some one has remarked that the insects crawl on their backs instead of on their bellies—a statement that is anatomically much more than a half truth. What corresponds in them to our spinal cord lies along the under side of the creatures' bodies; their hearts and stomachs, on the



Photograph courtesy U. S. Department of Agriculture

A GRAPEFRUIT FILLED WITH FRUIT-FLY PUNCTURES AND SHOWING THE MAGGOTS

A single fruit often carries as many as a score of punctures and sometimes as many as a hundred. The maggots are shown in the section from which the rind has been cut away.

other hand, are near the top surface. The skeletons of insects are made up of a series of segments or rings; and, whether in a grasshopper, a dragon-fly, or a moth, in an ant, a house-fly, or a bee, most of these segments are apparent, if examined closely. There are other classes of creatures that have these ringlike segmental skeletons, but to qualify as insects they must have no more than six jointed legs when in their adult form. The "thousand-leggers," the scorpions, the spiders, and the ticks are all cousins, but they are all technically ineligible for membership in the insect "lodge" because they have too many legs.

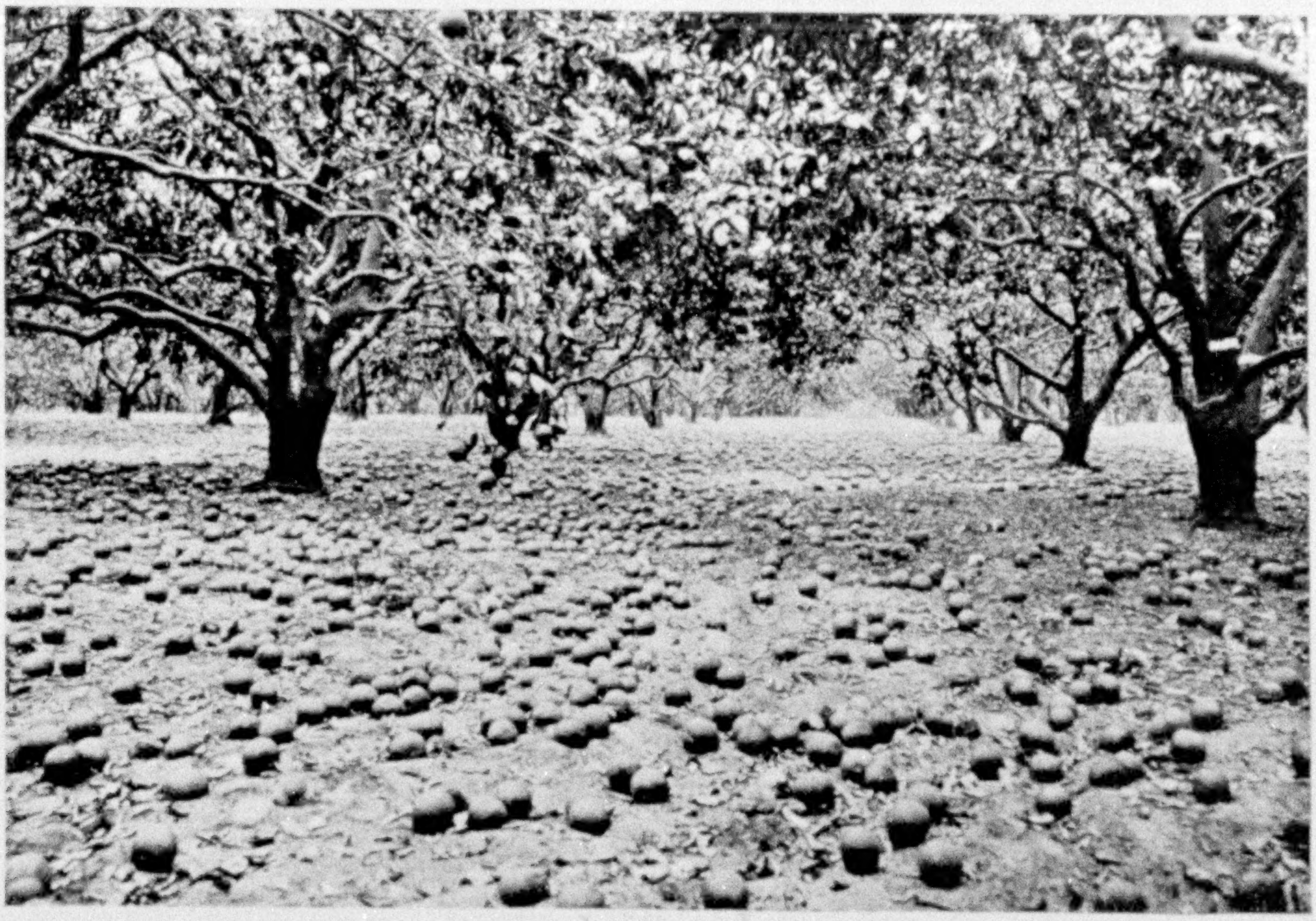
The circulatory system is amazingly different from our own. In most species the hearts are not complex organs like ours, with divers chambers and sundry valves, but are simple, hollow tubes that contract in waves from end to end. Their blood is not red like ours, but yellowish or greenish. They have no veins or arteries through which the blood moves; rather, it is sent directly through the body cavity, which is filled entirely therewith.

With us, the heart sends the blood to the lungs to be purified and given a new supply of oxygen for its return trip through the capillaries. The insects, having no lungs, get their oxygen, not through the blood, but through little breathing tubes known as tracheæ, which penetrate every part of the body.

FEEDING HABITS OF WIDE RANGE

The feeding habits of this class of creatures are of astounding range. The plant-lice, sucking the sap of rosebush, apple twig, or cucumber vine, love plant juices, just as the mosquito and the flea love animal blood. The honey-bee and the butterfly, drinking the nectar of the flower, are in strange contrast to the sexton beetle and the flesh fly in the quality of their respective appetites.

The wood-borers, satisfied to spend their larval lives eating naught but insipid wood, as they digest their paths through the heart of oak and hickory and elm, have tastes infinitely less spicy than those of the "weevils" that are never so happy as when feasting on Cayenne pepper, or



Photograph courtesy U. S. Department of Agriculture

AN ORANGE GROVE DEVASTATED BY THE MEDITERRANEAN FRUIT-FLY, WHICH HAS RECENTLY MADE ITS FIRST APPEARANCE IN AMERICA

In a bulletin published in 1918 the United States Bureau of Entomology said that there was little danger of the fruit-fly gaining entry through the medium of commercial shipments of fresh fruits. "But quarantine officials have found the pest in fruit concealed by tourists and in mail and express packages sent from infested countries by uninformed persons, and it is by such avenues that the pest is most likely to be introduced." The location of the infested area apparently justifies this prophecy.

of the beetles that know no gustatory joy so satisfying as eating cigarettes.

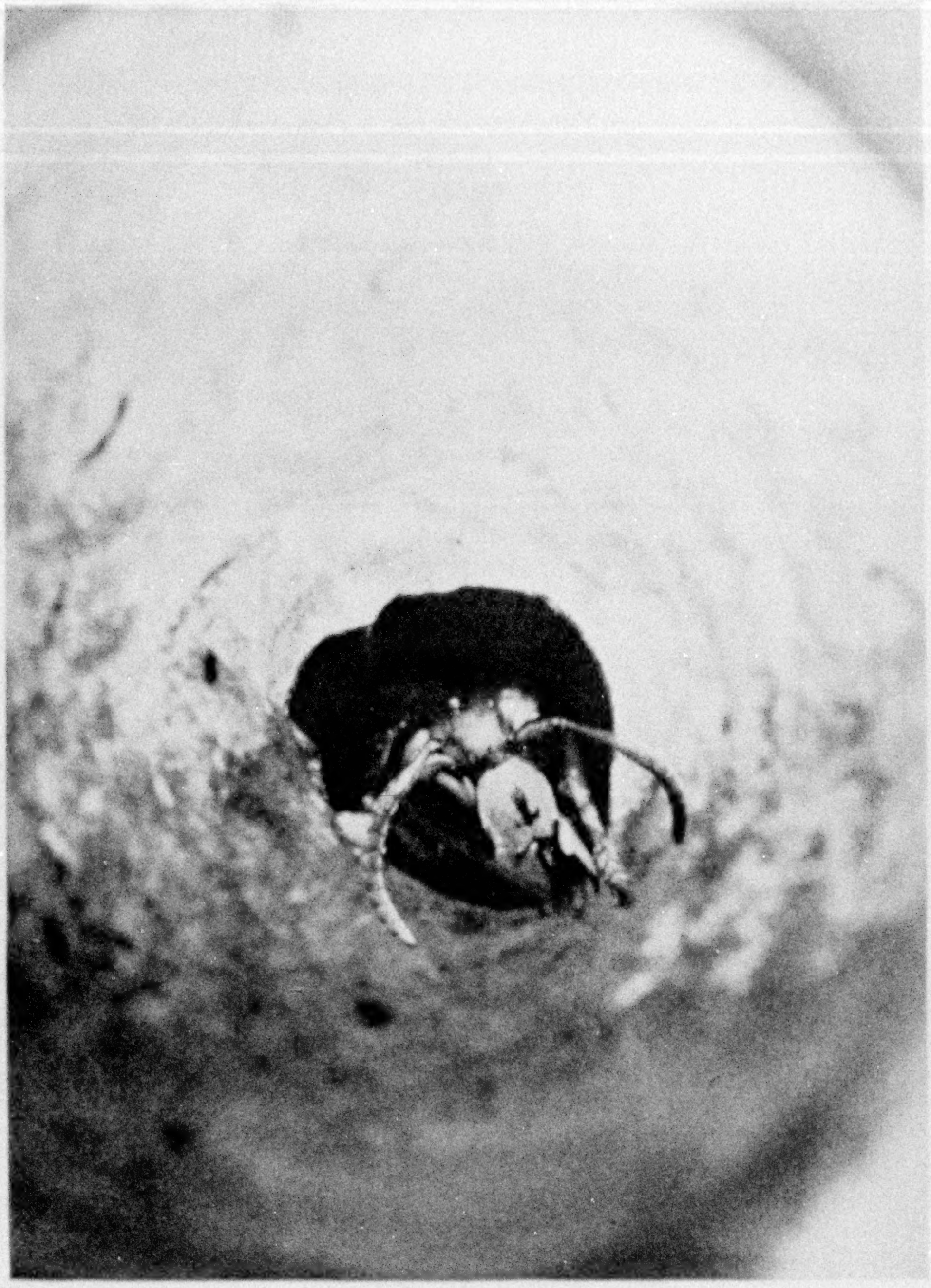
In the reproductive organs one finds the most startling departures from the orthodox. In evolving their social system, the community-building bees, ants, and wasps have developed highly organized females, which we know as queens, that are marvels of efficiency as egg-laying machines. They mate but once in a lifetime, and therefore have developed a tiny internal pouch in which the male life germs are held.

As they lay their eggs, the honey-bee queens (see Color Plate XII, figure 2) are able, at will, to open or close the orifice of this pouch that leads to the oviduct, and thus to determine whether each egg shall or shall not be impregnated. The ones that are produce females, and those that are not produce males. The queens, it will be seen from this, have come to be masters of the art of sex control.

Then the workers (see Color Plate XII, figure 4) come along with their own development of this art. By the quality of the food they give the female larvæ they determine whether these shall develop into full-sexed queens or whether their reproductive organs shall be so stunted as to make them practically sexless—worker bees. So well is the royal bee jelly compounded in the hive that even the beekeeper, feeding it to the larva in the cell, can produce a queen at will. Yet science never has been able to solve the secret hidden in this queen-making royal jelly.

THE SENSE OF SMELL

In some of the queen-possessing species the neuters will, in the hour of calamity caused by the death of their queen, select one of their own number to function as queen during the interregnum. The larvæ of these, fed the royal jelly, develop into



Photograph by Paul Griswold Howes

A COMMON HORNET STANDS GUARD AT THE ENTRANCE TO ITS NEST

The photographer obtained this picture by building a special scaffold for his camera and using sunlight reflected from a mirror. The hornets and other wasps were the world's first manufacturers of paper. The manner in which they enlarge a little nest smaller than a hen egg into one as large as a half-bushel measure, without disturbing its symmetry or opening up its interior, is a masterpiece in building (see text, page 50).

full-fledged queens, ready to start the colony on its normal course once more.

The sense of smell in some of the insects is almost unbelievably acute. The smelling organs are minute pits or projections on the antennæ and possibly in some of the mouth parts, so arranged as to leave the nerve ends exposed to every odor and at the same time protected from harm. For instance, on a single antenna of an ordinary June beetle there are as many as forty thousand of these olfactory pits.

Some species, with their antennæ removed or covered with shellac, are unable to find either food or each other. If their eyes are blindfolded with pitch and their antennæ left in normal condition, they seem to suffer no inconvenience.

Fabre's classic experiments with the great peacock and banded-monk moths* and with the truffle beetle show to what inconceivable lengths the sense of smell sometimes is developed.

The great peacock moth, the largest in Europe, is clad in chestnut velvet, with a necktie of white fur. Its wings, sprinkled with gray and brown, are crossed by a faint zigzag, edged with smoky white, and studded by a great eye with a black pupil and a variegated iris containing successive arcs of black, white, chestnut, and purple.

A female moth of this species emerged from her cocoon in Fabre's laboratory one May day. That night there came such a swarm of male moths that everybody was astounded. In the laboratory, in the kitchen, in the dining room they gathered. At least forty lovers had come to pay their respects to the marriageable bride born that morning. In eight days at least 150 wooers came to pay court to the moth virgin. Whence came they? Extraordinarily rare in Fabre's region, he thought that some of them must have traveled at least a mile and a half.

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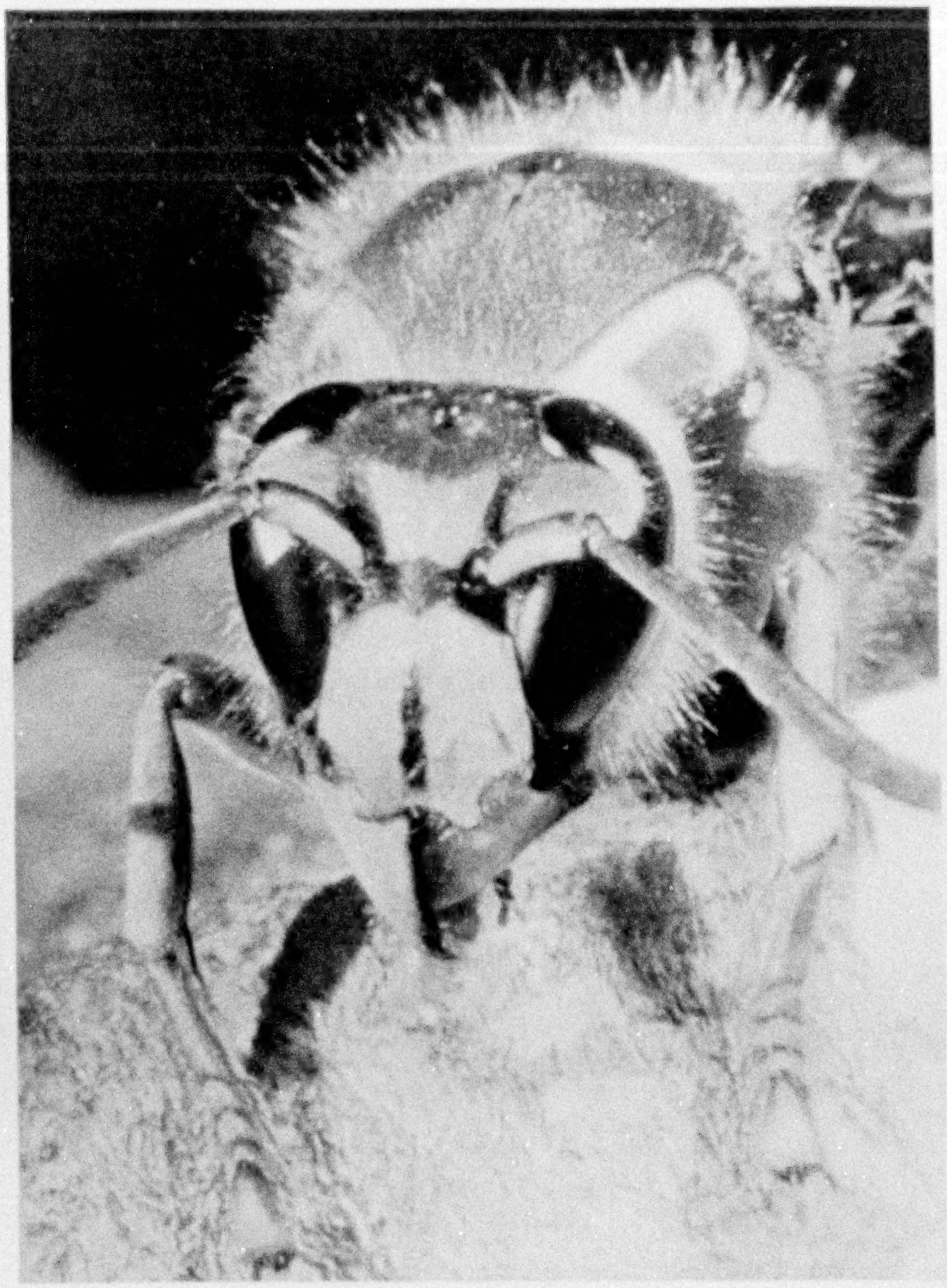
* See "Strange Habits of Familiar Moths and Butterflies," with sixteen pages of illustrations in full color, by William Joseph Showalter, in the NATIONAL GEOGRAPHIC MAGAZINE for July, 1927.

Surrounded with naphthalene, the young virgin's call still went forth and the lovers still came hence; but shut up in an air-tight jar, not a single visitor arrived to pay court. When the antennæ of a visitor were cut off, an operation through which he evinced no pain, he became powerless to locate his affinity, though she was only a few feet away.

So it was with the banded-monk, a day flyer. A chance cocoon fell into the entomologist's hands. The oaks, where the banded-monks made their home, were miles away. Three years of diligent searching upon his own part and that of his family had failed to reveal a single member of this species in any of its stages from egg to adult.



Photograph by Lynwood M. Chace

LOOKING A HORNET IN THE EYE

With its large kidney-shaped eyes, its jointed antennæ, and its pincerlike mandibles, a hornet presents a fearsome aspect when magnified. The members of this family feed their young chewed-up bits of other insects (see text, page 52).

But as soon as the newly hatched insect had reached the mating age swarms of banded-monk wooers came from somewhere out of the distance to pay court to her. This time the naturalist exhausted the whole list of powerful scents and stenches in an effort to overpower her "call." With what he called the concentrated odors of a gas works, a smoker's divan, a scent shop, an oil well, and a chemical factory, he still was unable to conquer the emanation that called the swains from over the hills.

We admire the amazing delicacy of the bird dog's nose. Going at a gallop, on his zigzag way across a field, he recognizes the scent of the quail from that of any of the thousand and one other odors issuing from grass and flower and shrub, from insect and bird and beast. Not only so; he discriminates between several kinds of quail scents, whether they be of the body, foot, or nest; whether fresh or old, or from birds approaching, standing still, or fleeing.

But even the setter's nose is a dull organ of perception beside the antennæ of moths, beetles, bees, and butterflies.

Photograph by Paul Griswold Howes

ANT GALLERIES IN THE CENTER OF A DEAD CEDAR TREE

At the base of the tree which furnished this picture were found fully two bushels of sawdust and chips which have been removed, bit by bit, by industrious carpenter ants (see, also, illustration, page 16). The termites join the carpenter ants in mining wood. Between them the beams of thousands of houses and other structures are weakened and in many communities the problem of termite-proofing structures becomes a serious one.

We are so accustomed to seeing animals with their organs of hearing located in their heads that we are astonished to find that insects have other locations for their ears, and that they employ several principles beside the tympanum in translating air vibrations into sound.

PECULIAR POSITIONS FOR EARS

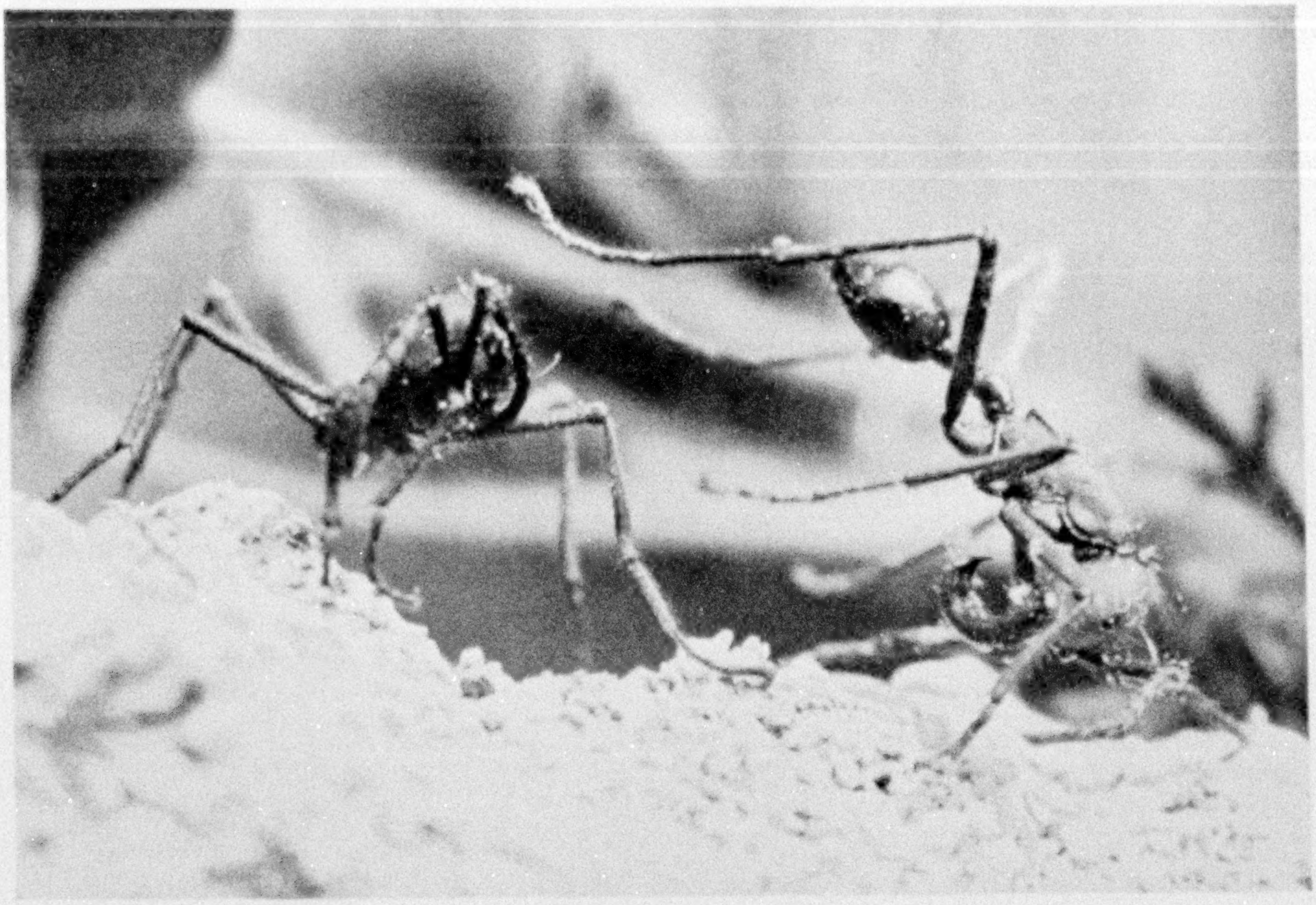
Among the short-horned grasshoppers (see Color Plate II) the ears are in their abdomens, immediately back of and above the point where the hind legs emerge from their bodies. These appear as small, clear, round spots on the surface of the abdomen.

Katydids and crickets hear with their front legs, in which are located the ears that catch the music of their sweethearts' songs. Among the mosquitoes and midges the ears are in the antennæ—very delicate hairs that communicate the sense of vibration to certain nerves, which, in their turn, transmit it to the brain.

The throat is no more the source of the insects' song than is the head the seat of their ears. Some employ the principle of the violin; others a variation of the drum; still others the idea of the reed. Some make secondary music with organs built after the fashion of the flute, while many employ sign language as effective means of communication.

DRUMMERS AND FIDDLERS

When one hears the sonorous accusation that Katydid (see Color Plate III, figure 3), it can be written down that another Adam is laying the charge at the door of another Eve, for the females of the Katydid family are voiceless. Mr. Katydid has his say with his wings. He rubs his nervure-roughened front wings together. On the one there is a filelike roughness, and on the other a resonant edge—an application of the fiddle-and-bow method of sound production. The



Photograph by Paul Griswold Howes

A PAIR OF ANTS MAKE THEIR TOILET

Living in dark burrows where the sun never enters, cleanliness is a rule of the ant community. They patiently scrub their bodies with their mandibles, so as to remove all adhering particles of dust. The positions into which they have to get to complete their tasks are often startling. Often one may be seen balancing itself on two legs and swinging its abdomen up to its mouth to brush and stroke it with meticulous care. The photograph is very much enlarged.

crickets also are Fritz Kreislers instead of Carusos.

The hum of many orders of insects is a sound produced by the reed method—the rapid vibration of a tongue of some material. In the case of the bee and the fly, one wing is the tongue. The droning among the flowers, the quivering notes when enmeshed in a spider's web, the high-pitched buzz when making a get-away from such a trap—all these speak so plainly, even to human ears, of amiability, anxiety, or anger that one cannot avoid the conclusion that the bee knows how to express her moods as well as we.

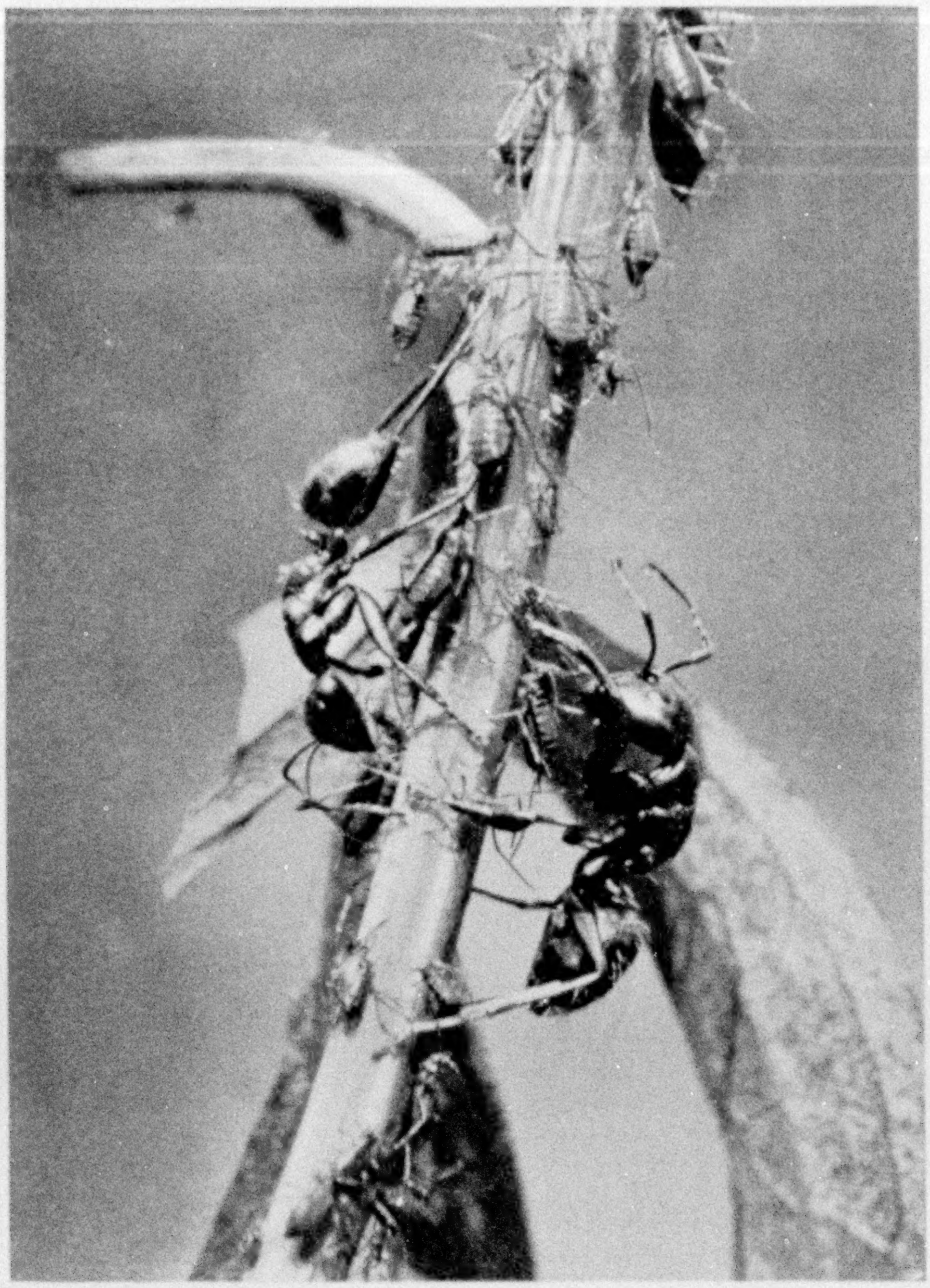
There is still another kind of sound production. When a fly gets fast in fly paper we hear its shrill, high-pitched, nervous cry, although its wings are pinioned by the glue. That sound comes from tiny tracheæ, or tubes, with which the body is shot through. The bees have a voice produced in the same way, and any bee-keeper will describe the piping of his bees.

It is by piping that the lady mosquito, intent on a meal of warm blood, gives the intended victim warning, thus proving that she is a bold highwaywoman rather than a cowardly thief.

FEATS OF STRENGTH AND ACHIEVEMENTS IN ENGINEERING

When man's strength and achievements in engineering are measured by the standards set by the insects, there are some phases of our success that are overshadowed entirely. In the last Olympics the record for a standing high jump was 6 feet 4⅜ inches. Yet the common flea—*Pulex irritans*, if you want his more exact name—is capable of jumping a hundred times as high as his own head. Were the Olympic champion high jumper able to do as well proportionately, he could clear the Washington Monument at a single bound, with some eighty feet to spare.

Likewise, if man's biggest structure were as large in proportion to the size of



Photograph by Paul Griswold Howes

CARPENTER ANTS AND THEIR APHID CATTLE

Many ants are stock raisers. They herd their colonies of aphids with as much care as a western plainsman tends his cattle. In utilizing the corn-root aphid a remarkable degree of intelligence is shown. In the fall the little insects are taken, in one or another of their stages of life, into the nests of the ants and carefully protected during the season of cold. In the early spring they are carried to the roots of the smartweed and other related plants, where they are "pastured" until the farmers' corn takes root. Then they are carried to the corn roots, which serve as grazing ground for the summer. Each aphid has a tiny tube on the upper rear part of its body, through which it secretes droplets of a sweetish substance which the ants drink with gusto.

the adult human frame as the Pennsylvania ant hill is to the size of the ants that built it, we could boast of a pile five hundred times as big as that wonder of the ages, the pyramid of Cheops; and the Eiffel Tower, built with the aid of all sorts of machinery, is no higher, proportionately, than the ant hill reared with claws and mandibles alone. If the modern baggageman could carry loads as heavy, in proportion to size, as the ants, he could lift a half-ton trunk to the top of the Washington Monument without apparent fatigue.

Kirby and Spence have pictured the strength of insects: "A wild bee or a Sphex (see Color Plate X, figure 1), for instance, will dig a hole in a hard bank of earth some inches deep and five or six times its own size, and labor unremittingly at this arduous undertaking for several days, scarcely allowing itself a moment for eating or repose. It will then occupy as much time in searching for a store of food, and no sooner is this task finished than it will set about repeating the process, and before it dies will have completed five or six similar cells or even more.

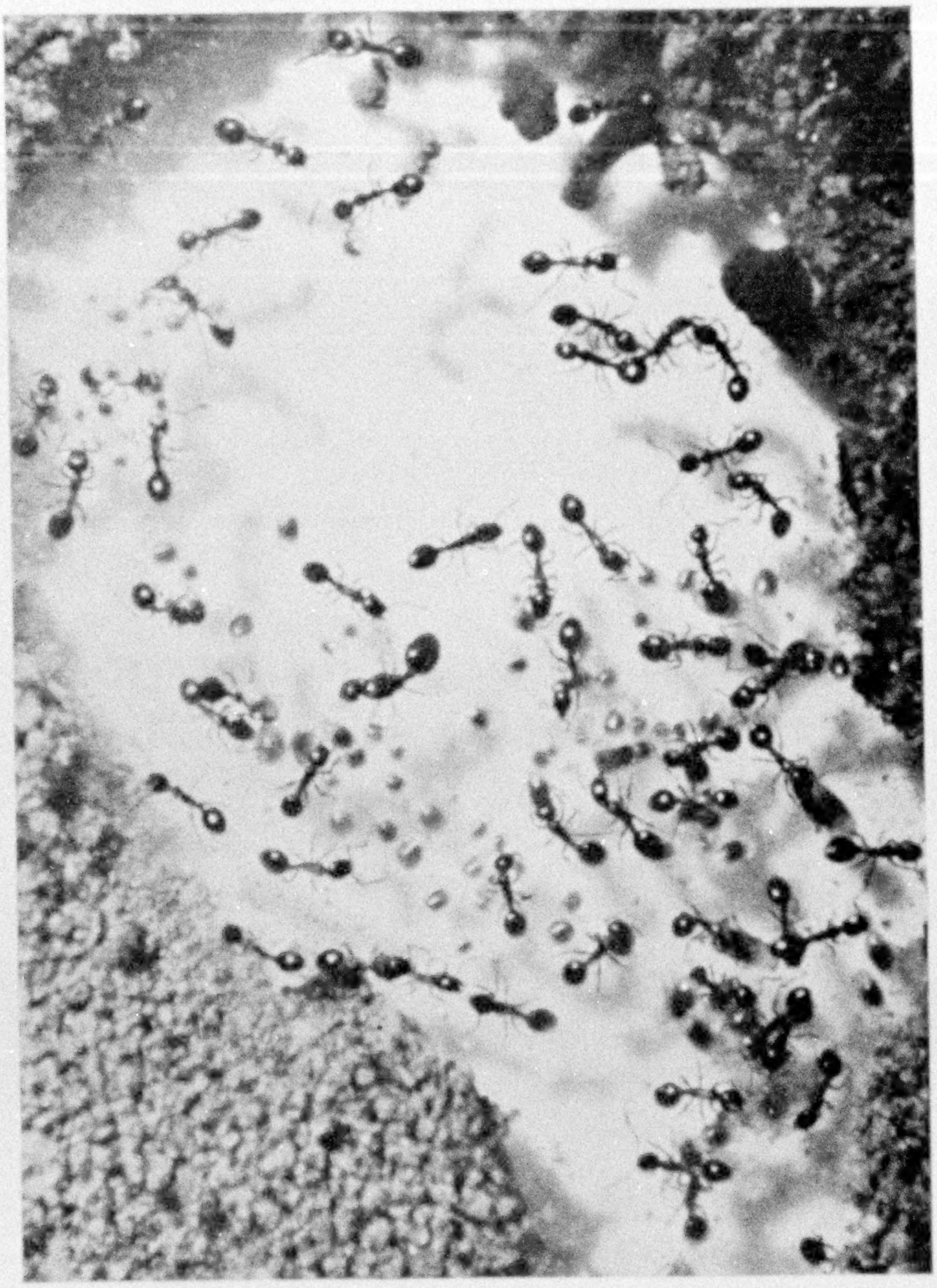
"If you would estimate this industry at its proper value, you should reflect what kind of exertion it would require in a man to dig in a few days, out of hard clay or sand, with no other tools than his nails and teeth, five or six caverns twenty feet deep and four or five square, for such an undertaking would not be comparatively greater than that of the insects in question."

THE COLORS OF INSECTS

Matching the fairest flowers that blow in the richness and iridescence of their coloring, some of the beetles, bugs, and bees rival the butterflies and moths, and even seem to challenge the rainbow itself, in their harmonies of hues (see Color Plates I to XXIV).

The dung beetles of the South American pampa, we are told, combine the fire of gems with metallic luster, and, according to the incidence of light, emit the green reflections of the emerald or the gleam of ruddy copper—rakers of muck that would do honor to the jeweler's showcase.

What Golconda do the scarab (see Color Plates XXIII and XXIV), the azure hoplia cockchafer, the golden apple beetle, and other species visit to gather their gems, and in what diggings do they find their golden nuggets?



Photograph by Paul Griswold Howes

THE BUSY ROUTINE OF AN ANT HILL

The queen is the largest individual, in the center of the picture. In the group of five ants in the upper right corner two may be seen combing each other, a third is carrying an egg, while the other two rest. At the top is a worker carrying a ball of earth. Whether herding aphid "cows" (see opposite page), making slave raids, growing "mushrooms," or looking after guests of the colony, the ants disclose a remarkable social organization.

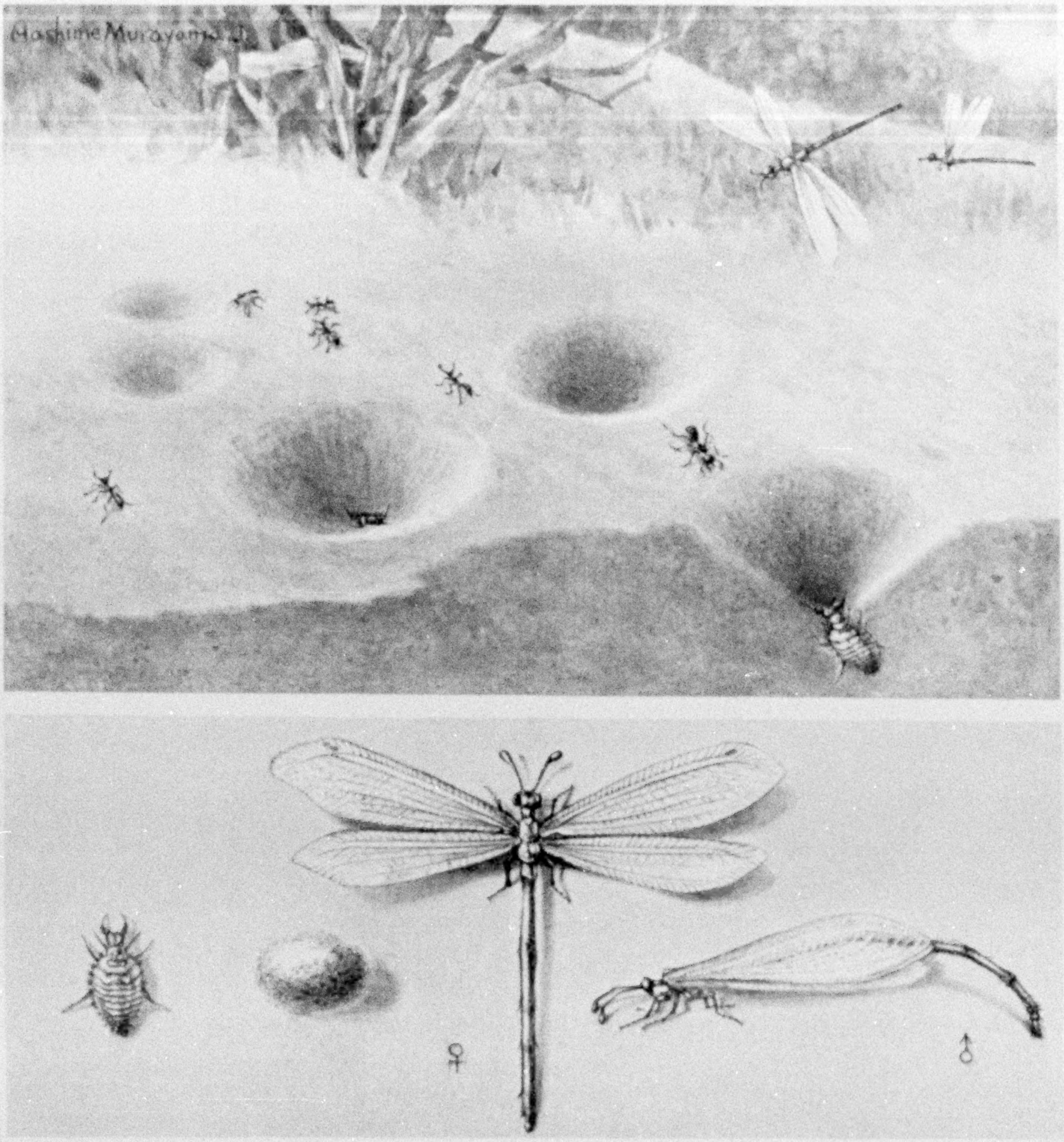
THE REASON FOR INSECT COLORS

The general harmonizing of insect color and pattern with the color scheme of usual environment is recognized generally. It is the art of camouflage developed by ages of necessity for low visibility. Those insects hardest to see have the best chance to escape the birds, the lizards, the toads, and the predaceous insects of other species. Even in a single species, varieties of coloring are found in different localities. In each case the harmony between the insect and its environment is maintained.

Some insects mimic the colors of other species as a protection. The mimicking species are edible to their natural enemies, while the mimicked ones are noted for their repellent taste and therefore are given a wide berth by insectivorous creatures. The nearer the edible folk can imitate the nonedible, the better chance they have to escape a hungry mouth.

THE SEVERAL STAGES OF EXISTENCE

On the other hand, there are some insects noted for their high visibility rather than for their success at camouflaging. They are nearly all distasteful to the insec-



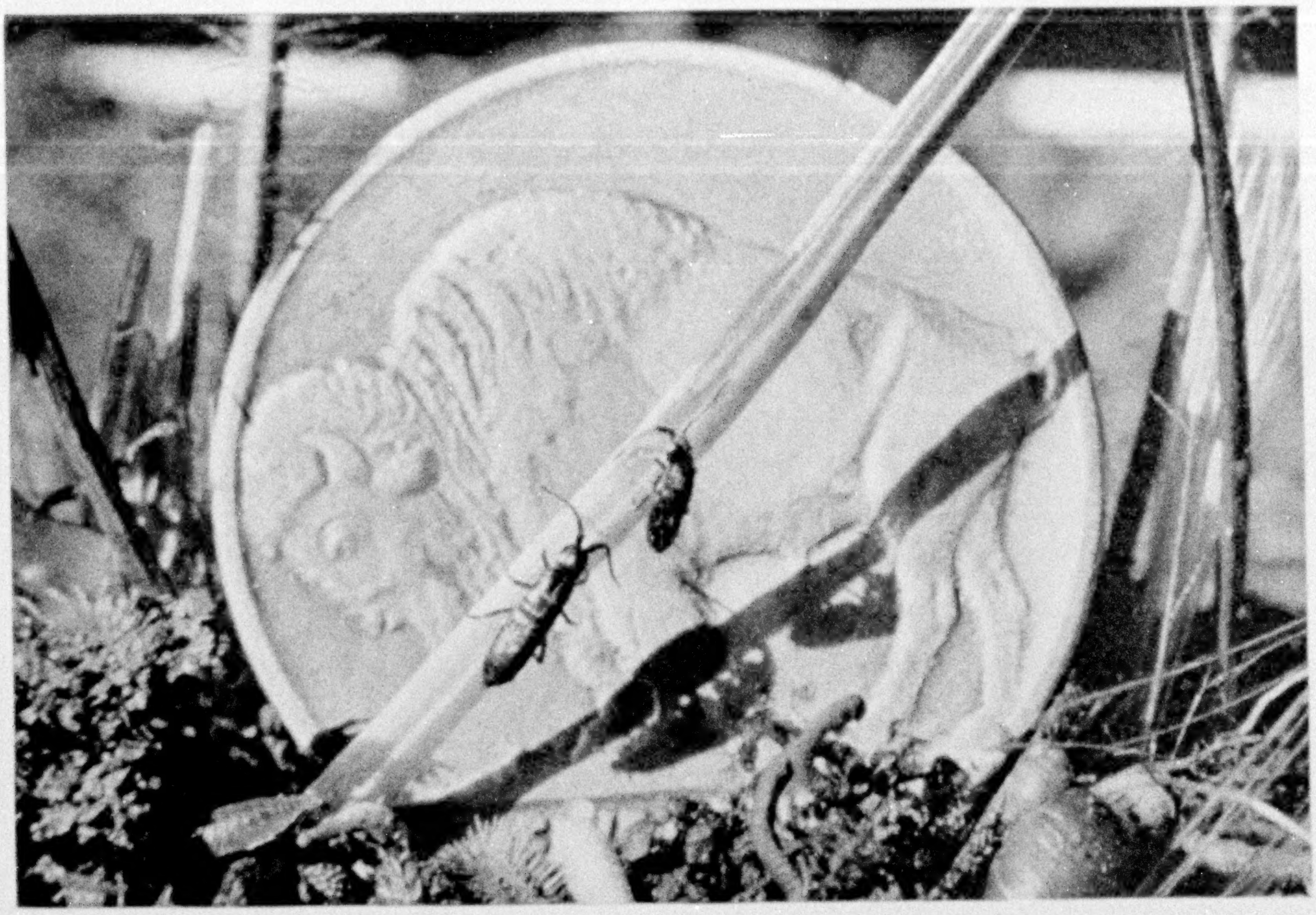
Painting by Hashime Murayama

TRAPS MADE BY WINGED LIONS TO CATCH ANTS

Often one sees symmetrical little craters in dry, sandy spots. These are pitfalls for ants. The winged lion shown below (female left, male right) lays her eggs in sand, and out of these emerge larvæ in the form shown at the lower left of the picture and at the bottom of the cutaway crater. The ant that slips over the edge of one of these traps finds the sand exactly at the angle of repose and can get no foothold to crawl out again. The larva, sensing his struggles, comes out of the sand and captures him. One may induce the little creature to come out simply by tickling the sand in the crater with a straw.

tivorous folk, and they advertise themselves in bold-face type, so that the foe may "read as he runs" that they do not belong to the edible species. Some moths and flies (see Color Plate IX) that are perfectly harmless duplicate in coloration, as well as in outline, bees and wasps that have frightful stings.

The transformations that take place in the insect world are marvelous adaptations to environment. From the tiny egg to the repulsive caterpillar, and thence to the beautiful butterfly; from the slim egg to the fat grub, and thence to the iridescent June beetle; from submarine-building caddis-worm to the lace-winged fly; from



Photograph by Paul Griswold Howes

A GROUP OF SPRING-TAILS BEFORE A BUFFALO NICKEL

These are among the most primitive of the insects. They possess a triggerlike apparatus on the under side of their bodies. When the trigger is released the insect is able to spring great distances. The spring-tails occur all over the world—on land, water, and ice.

the microscopic bee-louse to the blister-beetle—these are a few of the changes that take place in many species.

THE SEVERAL STAGES OF EXISTENCE

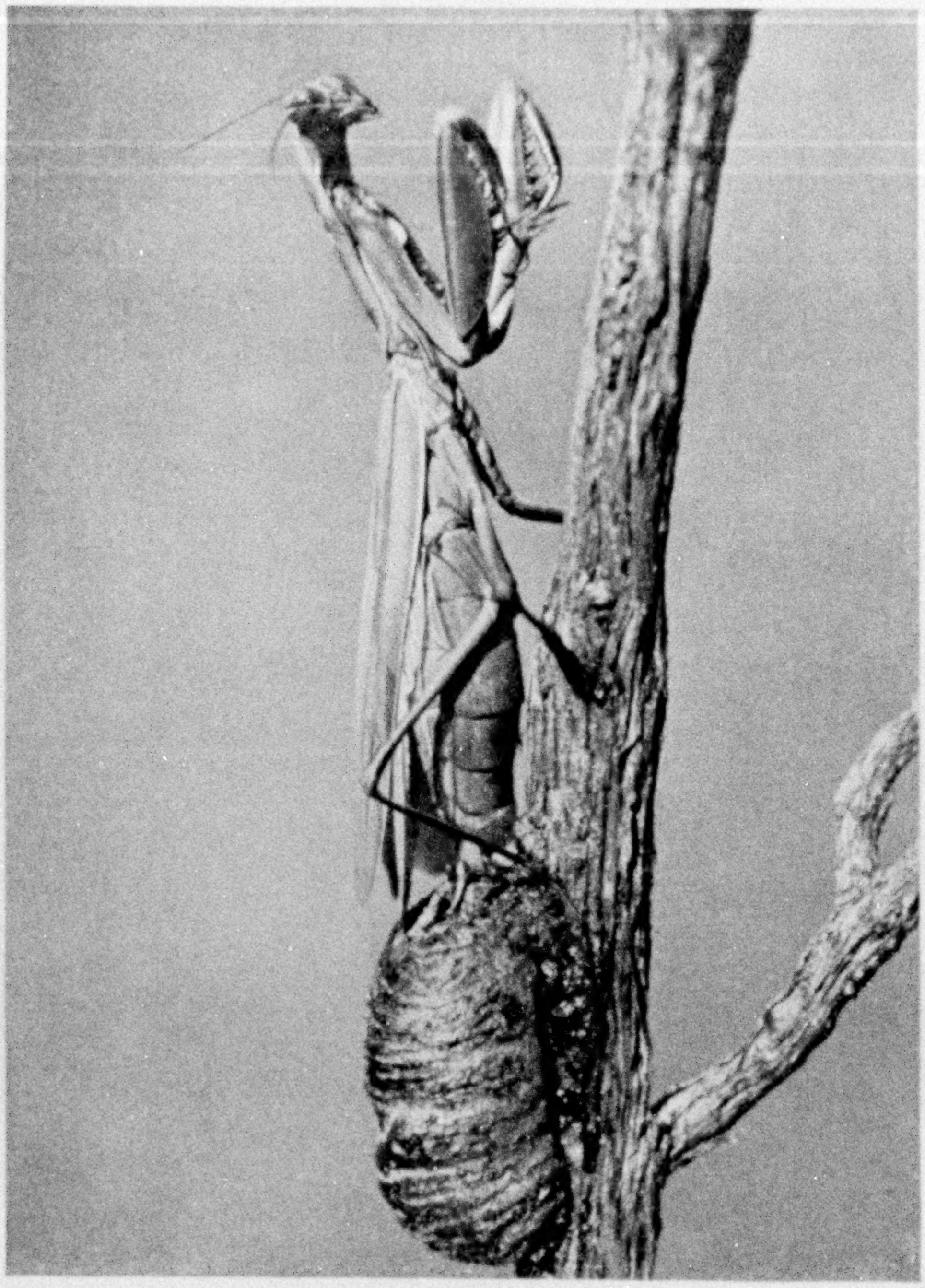
Some species undergo no striking changes on their journey from the egg to the grave except to grow wings. Other species, more numerous, such as the locusts, katydids, crickets, and dragon-flies, undergo striking changes of environment and partial changes in their make-up. In their larvæhood they live in the ground or the water. As adults they could not survive such surroundings. They have many molts. As they outgrow one suit of clothes, it splits open on the back, and they creep out, all "dolled up in a new bib and tucker" of more liberal dimensions. This hardens because of the chitin in it, and splendidly serves its purpose until again the body is too big for its garb, when another splitting on the back marks the acquisition of a more commodious garment.

Various species have their own definite number of molts. The Seventeen-year Locust is thought to get twenty-five new costumes during its heyday of life.

But the beetles, the butterflies, the moths, the bees, the ants, the wasps, the fleas, and such undergo utter transformations—from the egg to the maggot, from the maggot to the pupa, and from the pupa to the fly; from the egg to the caterpillar, from the caterpillar to the pupa, and from the pupa to the moth. The muscles change, the digestive tract is transformed, the creature's whole being is so made over that the environment of its one form would be fatal to its other.

Imagine a butterfly eating solid food, a June beetle (see Color Plate XXIII, figure 9) forced to live under ground, or a caddis-fly trying to dwell at the river bottom!

But the caterpillar does not eat for today alone. It foresees a morrow when, undergoing its transformation, it will have to spend days on end without a single bite



Photograph by Paul Henri Fabre

A PRAYING MANTIS (ACTUAL SIZE) LAYS HER EGGS

The mantids deposit their eggs in curious masses, covered with a quick-drying mucus, on branches and plant stems, in the late summer and fall. From these the young emerge during the following summer and soon grow to maturity, molting several times and developing wings in the interim (see text, page 28).

of food, the while its entire interior, except possibly its nervous system and reproductive glands, turns into a thick fluid in which float bits of degenerating tissue. While the débris of the disintegrating larval body is being melted into liquid in this strange alembic of Nature, the fluid, in its turn, is being transformed into new tissues and new organs.

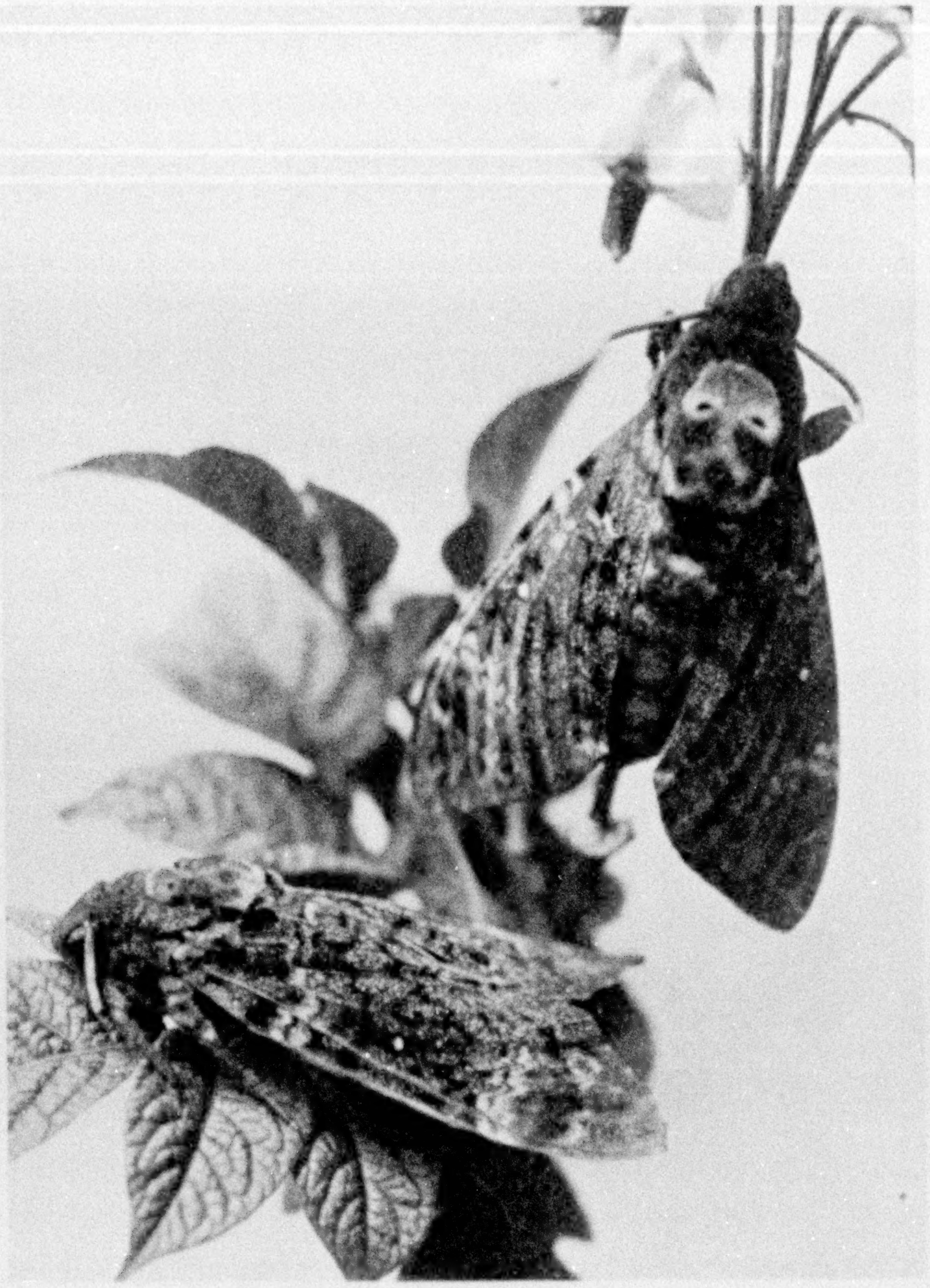
MARVELOUS MANIFESTATIONS OF INSTINCT

"One marvels," observes an English naturalist, "at the skill displayed by the bird in constructing its first nest; but it may be said that the newly mature bird has at least had a chance of watching a second-year matron of its kind building and getting some hints that way. In the case of the insects there is, as a rule, no possibility of such help. In the majority of species the mother is dead long before the daughter comes to that stage of existence when the necessity of providing for her progeny arises; so the knowledge has to pass by way of transmitted memory.

"Somewhere in the minute speck of protoplasm constituting the egg of one of the solitary bees, for instance, there is an infinitesimal particle of nerve matter which contains the secret of how to cut accurate circles and ovals of roseleaf so that a given number of them will overlap and curve into a perfect cylinder. During the greater part of its life the creature which hatches from that egg will have no need of the secret, but the germ of it will go on developing, and when the bee has reached its adult form there is the idea in the memory cells ready to instruct the nerves that govern the action of wings and legs and cutting jaws."

The milkweed butterfly sips the nectar of flowers and never touches green leaves. Its caterpillar, however, would starve on rations of nectar. The butterfly knows, or—to be literally accurate, instead of figuratively correct—acts as if it knows, that the caterpillars which are destined to hatch from the eggs it lays must have green food, so it always lays them on leaves.

Likewise, one of the Meloe blister-beetles, cousin of the Spanish fly, lays its eggs by the thousand—perhaps four thousand the first day, three thousand the second, two thousand the third—near the burrows of certain mining-bees. Then, exhausted by the Herculean task of insuring the perpetuation of the species, the mother beetle crawls away and dies. Presently an innumerable host of small creatures come out of the ground, seek out the flowers frequented by the bees, such as the composites, and then hop onto the bees' backs as they come for nectar and pollen.



Photograph by Paul Henri Fabre

THE DEATH'S-HEAD SPHINX MOTH

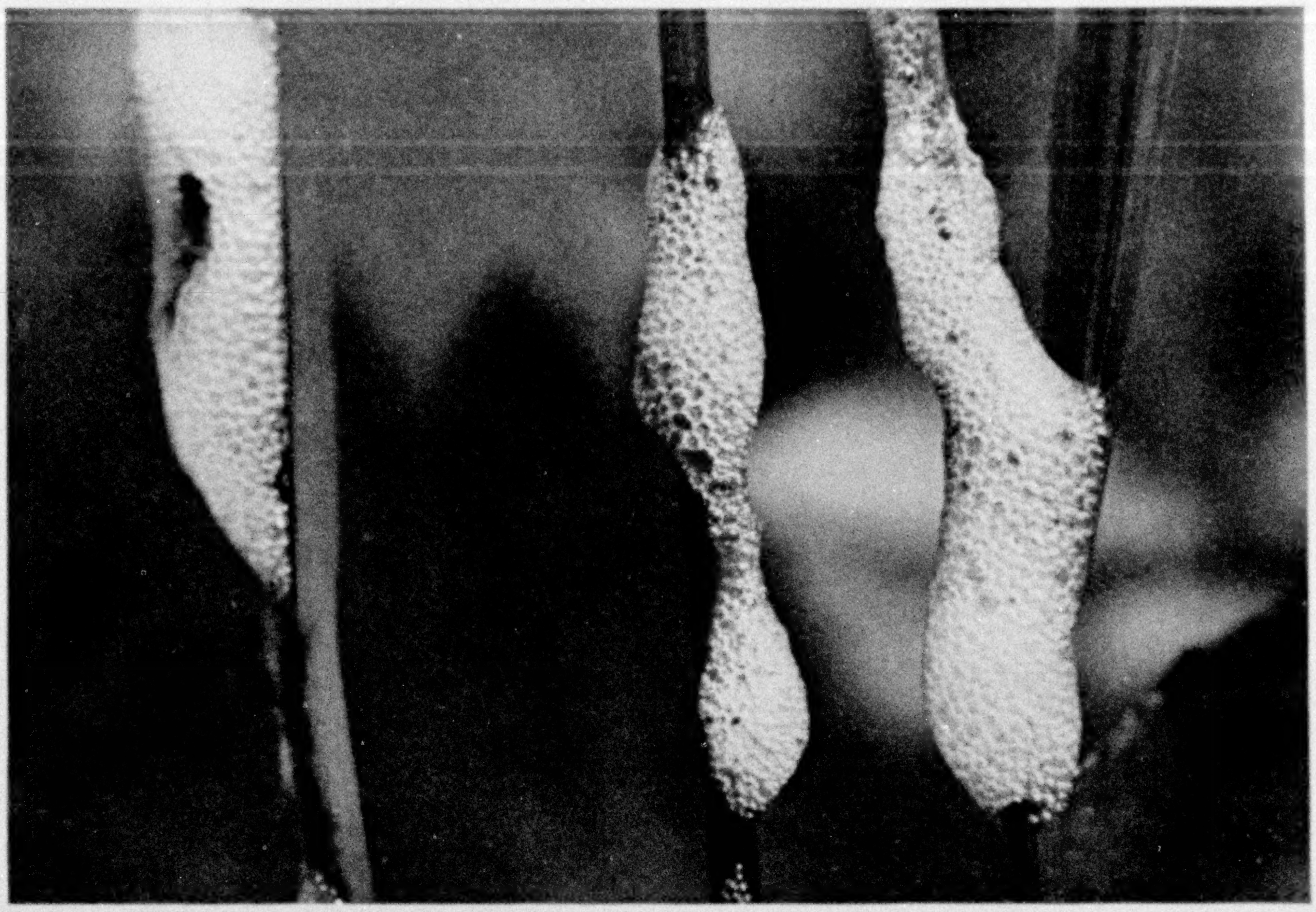
Somehow this strangely marked insect has learned the secret of the queen bee's piping and has mastered the art of imitating the call of the mistress of the hive. The bees could without difficulty sting it to death. But they allow it to enter without protest and to lay its eggs. The larvæ spin webs that do great damage to the bees' household.

A MURDERER UNMASKED

For a long time these tiny creatures were believed to be a species of louse infesting the bees, until Newport, the English entomologist, found them to be the babies of a Meloe beetle. Then Fabre studied them and found further that after one is safely ensconced in Mrs. Bee's fur it rides around on its animated airplane until she has provisioned her cell with pollen and honey. Then, at the moment the bee lays her egg on the pollen and honey, the little scamp makes a flying leap from the back of its hostess and lands on the newly laid egg, which it proceeds to use both as a life raft and a larder.

The poor bee, aiming to plant a germ of life, unwittingly permits this germ of death to fasten its tentacles to her hopes. She seals up the cell, but not for her own. The baby Meloe promptly tears open the shell and proceeds to feast upon the contents of the egg. Then it goes to sleep. For several years it stays in the cell it stole from the bee, taking divers naps therein, each time waking up transformed, and finally emerges a full-fledged Meloe beetle, ready to start the cycle all over again.

Only once in its life did the tiny creature have occasion to seek out a plant in which to hide; only once, occasion to steal



Photograph by Paul Griswold Howes

MASSES OF FROTH MADE BY FROG-HOPPERS

The frog-hoppers are a group of small, flat, brown or gray insects, which occasionally occur in sufficient numbers to injure grapes, cranberries, or pasture grasses. They get their popular name from the belief that these masses are the spittle of tree frogs. Their young, which in the earliest stages have no wings, a little later developing wing pads and finally wings, often are found imbedded in these masses, which apparently are used for a shelter.

a ride; only once, occasion to select a laying place contiguous to the harvest bee's home. Yet, with all the order of the succession of notes in a run on the piano, each act was performed with a sureness and a deftness as only man can show in his doings after years of training.

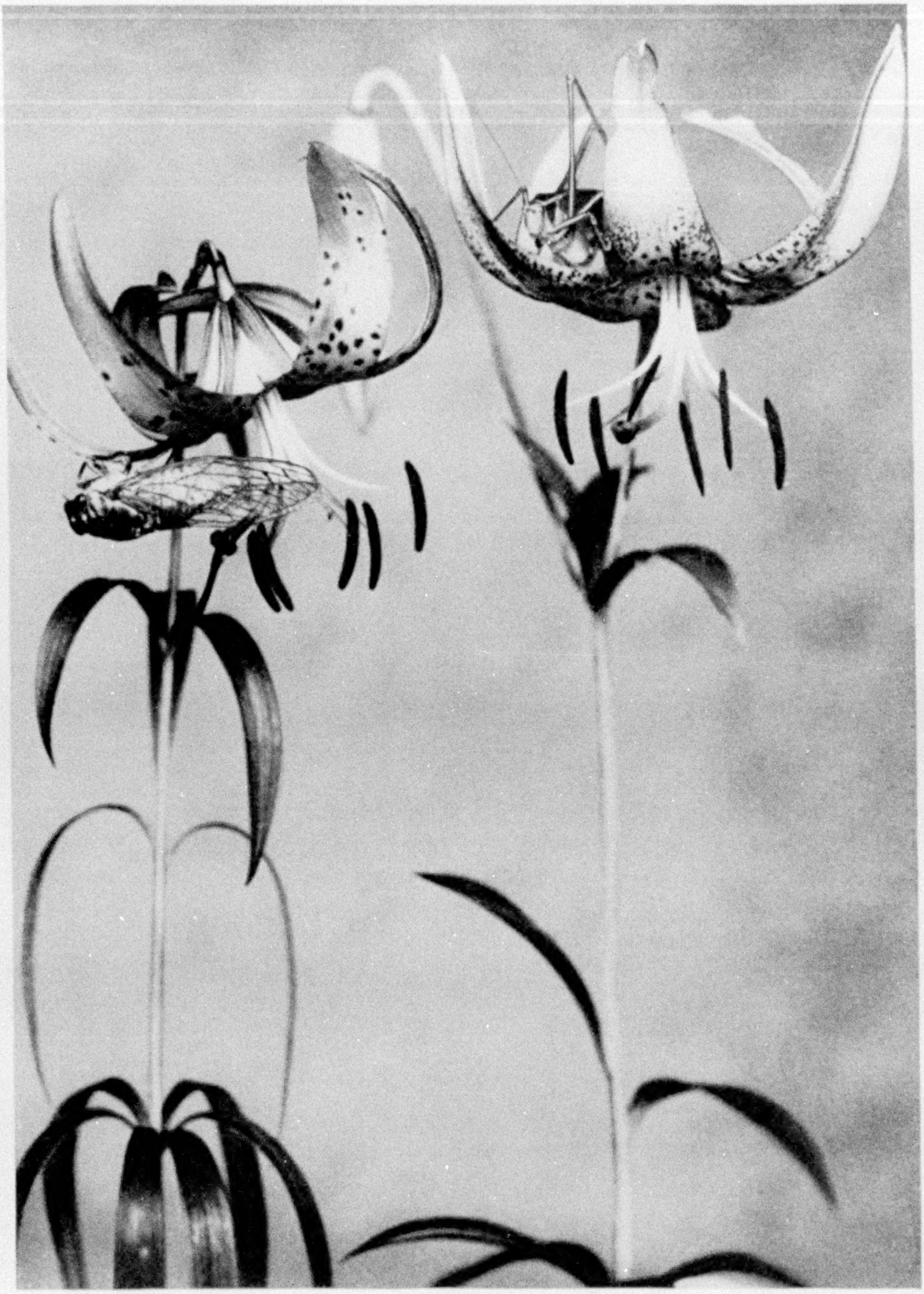
THREE YEARS IN THE SILENT HEART OF THE OAK

So, too, it is with the oak-boring grub and the long-horned Capricorn beetle (see Color Plates XX and XXI) into which it is transformed. From an egg in a crevice in the bark of a tree does this grub come into existence. The mother is dead long before the grub begins to live. A tiny creature it is when emerging from the egg, but with a powerful set of woodworking tools in its head.

Three years it will spend eating its way through the wood of the tree. In the silent, somber solitude of the oak's inmost heart it eats its ever-broadening, ever-lengthening path. It has no eyes, for of what use could eyes be to a creature living in the utter absence of light? It lacks ears, for what could there be of interest for it to hear when utter stillness reigns perennially? And nose—what warning could a nose give, what gustatory delight, what olfactory happiness, where there is nothing but oak wood to meet, nothing but oak wood to eat, nothing but oak wood to smell?

And yet "this-nothing-at-all is capable of marvelous acts of foresight; this belly, which hardly knows aught of the present, sees very clearly into the future." After three years of eating, it finds itself called into the deep sleep from which it is destined to awaken as a full-fledged, stiff-armored, long-horned Capricorn beetle.

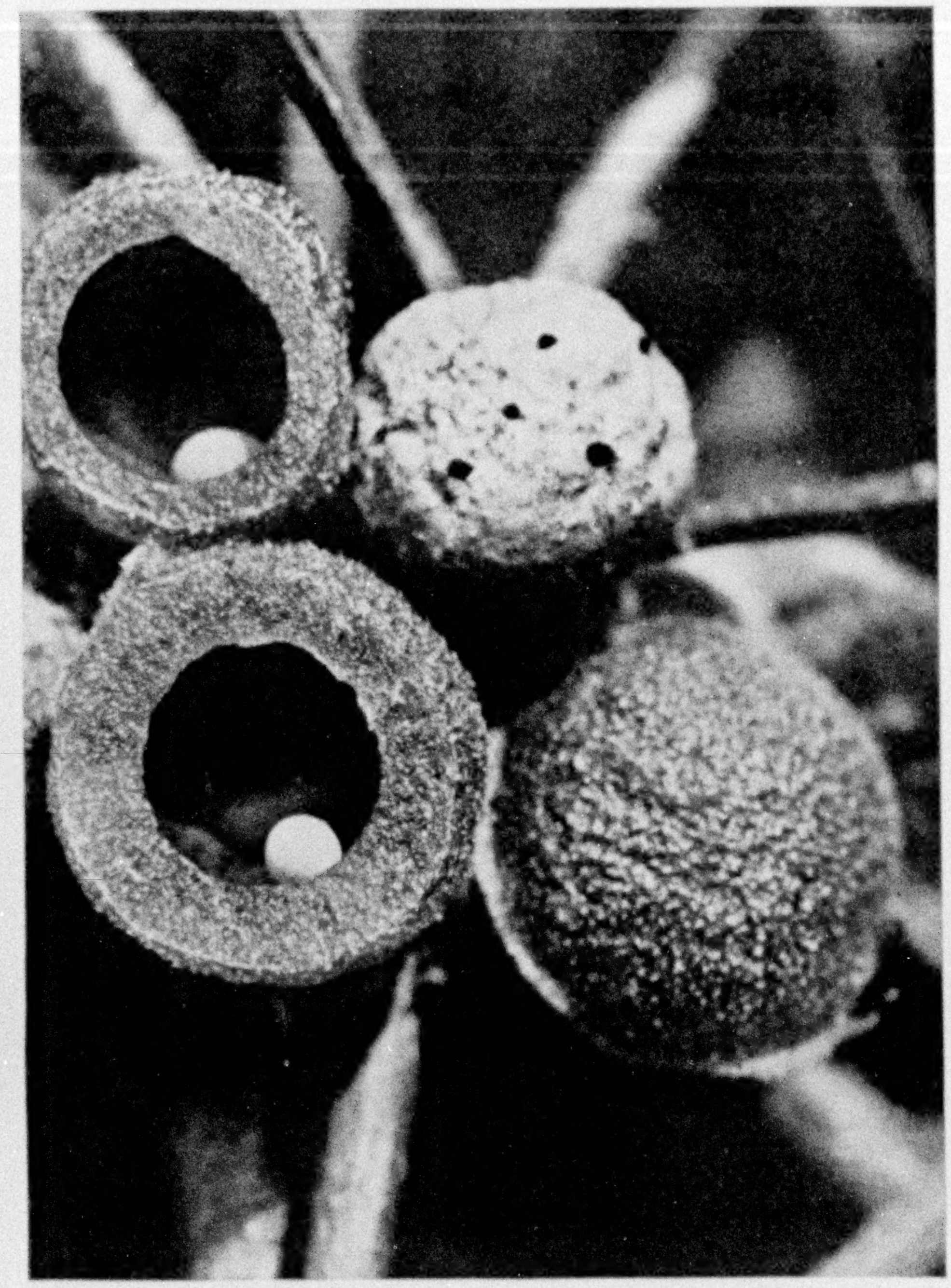
Urged on by an unfathomable presentiment to prepare for what never has happened before in its experience, at this juncture the grub bores to the surface, even braving the keen ears of that ancient



Photograph by Lynwood M. Chace

A SONGSTER OF THE DAY AND A SERENADER OF THE NIGHT

Hanging on the Turkscap lily at the left is a harvest-fly whose tuneless buzz fills the air on an August day. Upon his colorful balcony at the right Mr. Katydid looks out upon the scene. But his undefined accusations against the mysterious Katy (see text, page 14) will not be heard until eventide, when the harvest-fly is wrapped in silence.



Photograph by Paul Griswold Howes

A GROUP OF GALLS MADE BY INSECTS

One often notes galls on plants of many kinds. While some of these peculiar formations are caused by certain kinds of fungi, most of them are produced by insects. The two open and one closed gall are of a type developed by one of the ichneumon flies. The whitish gall was produced by another species, whose young have emerged. In the two opened galls lie small capsules, out of which would have emerged young saw-flies if they had been undisturbed. The gall-making insect lays its egg in the twig, where an irritation results in a swelling which serves as a shelter for the young.

foe of its race, the woodpecker, in order to provide an exit way for the beetle to be. Then it retreats a bit, excavates a transformation chamber, which is lined with a swan's down fabricated from sawdust. This is barricaded with triple doors made from uric-acid secretions and bits of wood fiber. After these elaborate preparations, the grub lies down to the deep sleep of the transforming period.

But does this sleep-overtaken grub ever turn its head away from the exit? Not it, for by some strange plan of Nature this animated sausage has inherited the guidance that makes it act as if it had full foreknowledge that it is destined to wake up a full-fledged beetle, too stiffly armored and too well provided with horns to permit it to turn around in its narrow cell.

STRANGE COMBINATIONS OF WISDOM AND IGNORANCE

Perhaps the French larva known as the Pine Processionary, a tent-building caterpillar resembling in some ways our own familiar apple tree tent-caterpillar, affords entomology's classic example of blind ignorance coupled with seemingly surpassing intelligence.

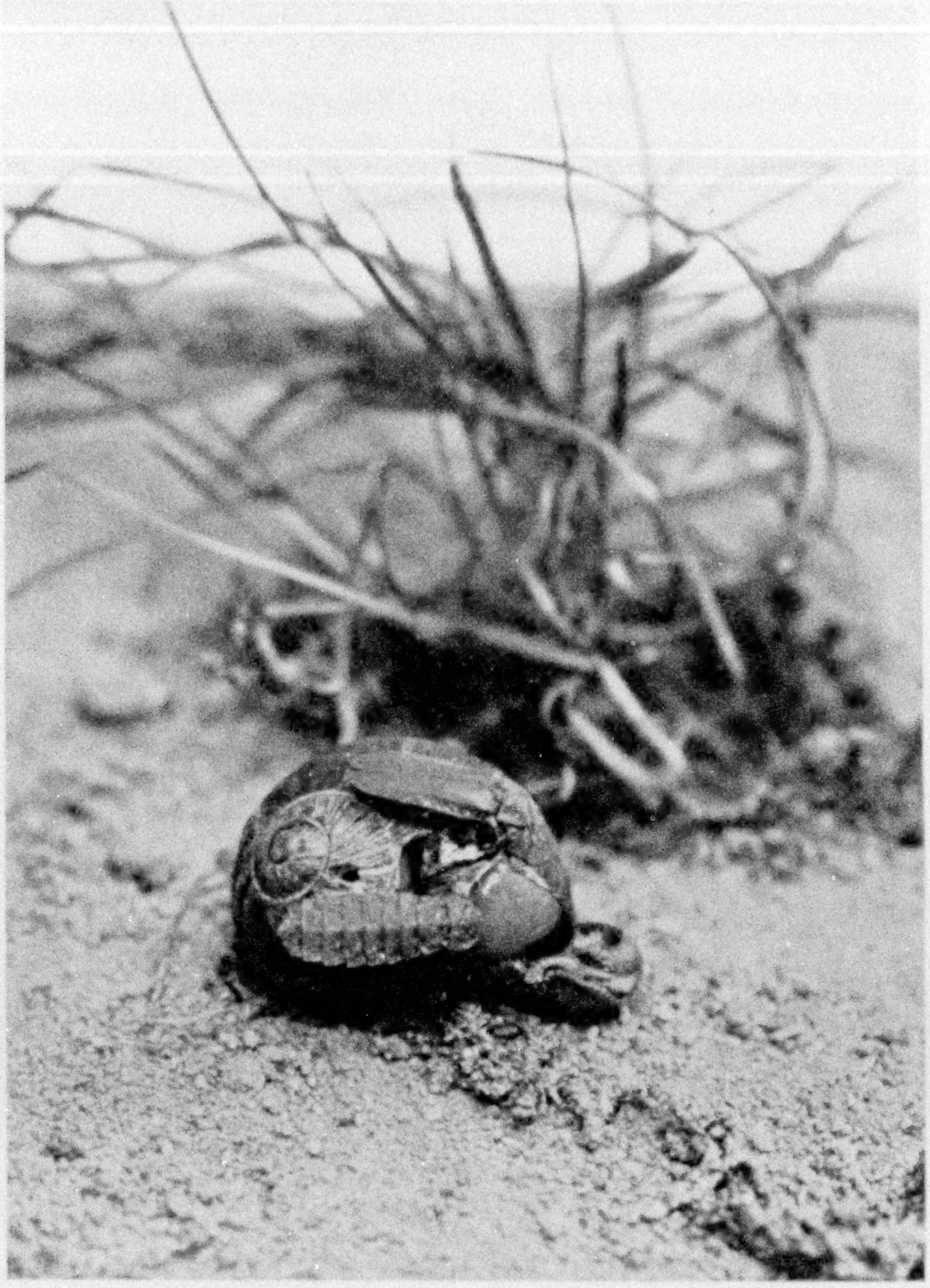
Fabre, in his "Souvenirs entomologiques," gives a dramatic picture of this caterpillar's behavior under varying circumstances. It is the larva of a moth closely related to the silk-worm moth. In laying her eggs, this moth takes down from her own body to make a cover for her eggs, just as the eider duck plucks the downy feathers from her own breast to make a warm nest for her young.

After emerging from the clustered eggs in late summer, the tiny caterpillars set to work to build themselves temporary silken tents; but when the tang of autumn touches the air, they construct a larger habitation, of such strong silk that it can weather the winter gales without difficulty. By the end of winter this may be as large as a half-gallon measure — "the interior a combination of a ragshop and a sewage farm."

As they march forth from their tent on a sunny day for a meal of pine needles, the caterpillars travel in single file. There are no natural leaders, whichever happens to go first being, for the moment, the leader. Now it is this one and now that, but each caterpillar leaves a trail of silk behind it that acts as a life line to guide it back from the grazing grounds to the nest.

One day Fabre succeeded in getting a procession to start around the rim of a big palm vase. He cut the line where it reached the rim, and the caterpillars, completing the circuit of the rim of the vase, unwittingly, guided by the life line they had left behind, started around again. All day long they kept marching around and around, for there was a solid ring of caterpillars, each with its head to the tail of the one before it. Far into the night they still journeyed on, slaves to their life line and bound to follow the one ahead. Morning dawned, finding them motionless and in a torpor, but still in formation.

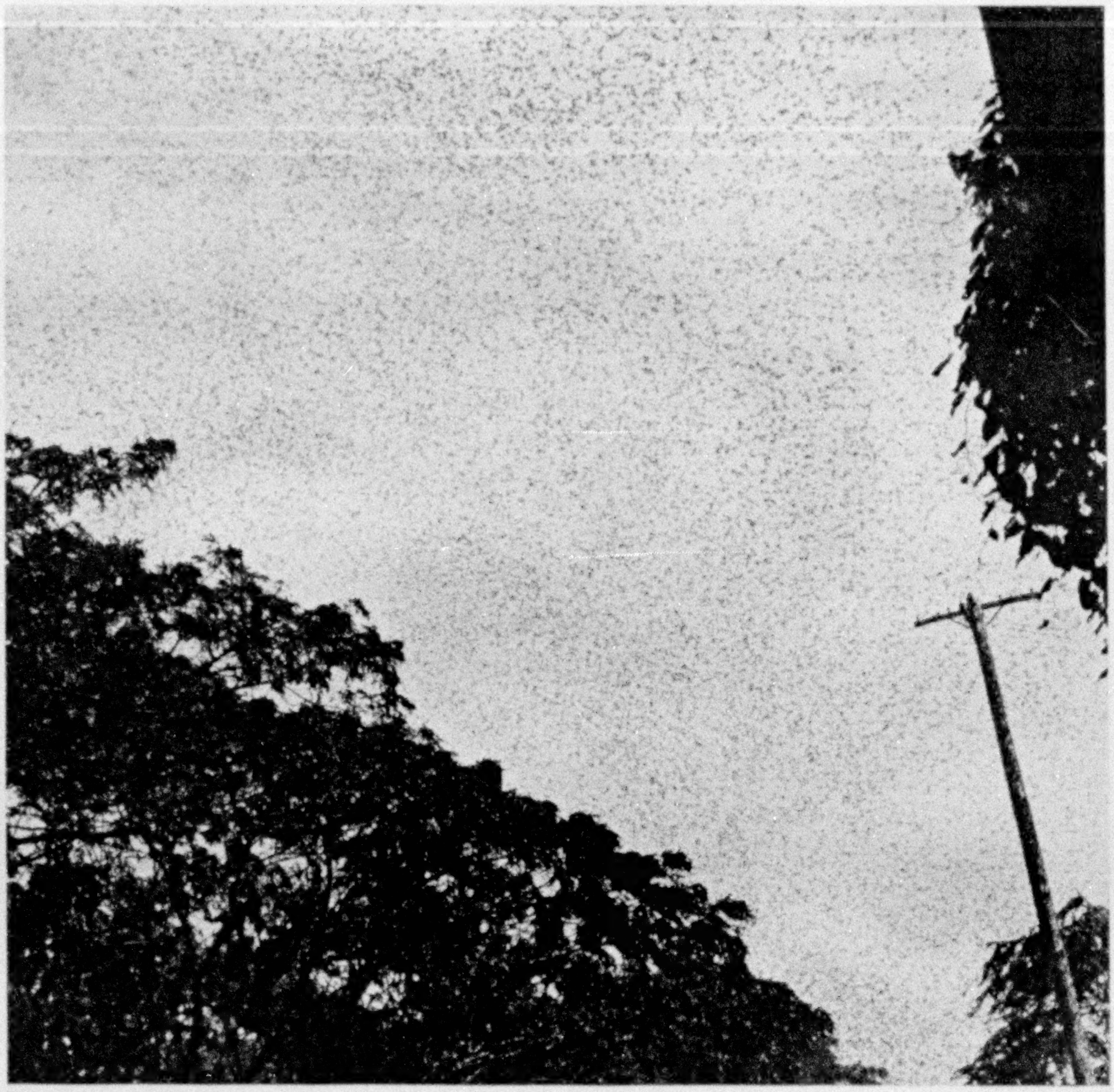
With the warmth of the sun upon them and the urge of their appetites within them, they resumed their patient march. On and on, around and around they went. Night came again, with its weary halt, and another morning with its patient resumption of the unending path. A few stragglers sought a way out of the circle, but came back and resumed the gruelling march. The third night came, with its halt, and another morning with its marching. So the fourth and the fifth. Footsore and weary, there were stragglers and confusion. The ring of caterpillars became a series of short processions, which again were united before the close of the



Photograph by Paul Henri Fabre

A GLOWWORM EPICURE DINES ON SNAIL

Stealing up on the snail, the assailant administers an anesthetic so subtle that the victim is not aware that it has been attacked. After the anesthetic has become effective the glowworm covers small sectors of the victim's body with a peptonized saliva, which predigests the snail's tissue and turns it into an edible broth.



Photograph by Charles Martin

A FLIGHT OF LOCUSTS OVER AN ISLAND OF THE SULU SEA, PHILIPPINE ISLANDS

day. The sixth night, the seventh day, the seventh night, and still the go-round that was far from merry kept up, and with its marchers as footsore and weary as were ever members of Stonewall Jackson's foot cavalry or John J. Pershing's heroes of the Argonne drive. The eighth day dawned, and with it came a desperation that led them singly and in groups to fall out of ranks, and before night had come again the last one had found his nest once more.

FORECASTERS OF THE MORROW'S WEATHER

Eighty-four hours on the march and eighty-four in bivouac, with never a mouthful to eat, with never the comforts of the home nest, all because of a slavish devotion to a life line and the instinct to follow the fellow ahead!

Prize "boneheads" of insectdom? Perhaps so. But wait! These same caterpillars, to whom being caught out in a rainstorm would be fatal, have developed, Fabre tells, methods of forecasting the weather that for weeks, during careful observations and comparisons with the records of the French Bureau of Meteorology, showed an amazing foreknowledge of the approach of foul weather.

Fabre, who has been called the "Homer of the Insect World" and the "Incomparable Observer," and whose son is following in his footsteps through his striking photographic researches, as revealed in many of the illustrations accompanying this article, has written at length on the strange intermingling of blank ignorance and surpassing foresight among the winged hosts.

SKILLED INSECT SURGEON HAS A MENTAL "BLIND SPOT"

The Pelopæus wasp, a splendid potter and an exquisite surgeon, able, with equal facility, to build an ideal cell for her unhatched young and to paralyze, without killing, the spiders with which she provisions it, was unable to detect the removal of the first spider, with its attached egg, when she brought in the second one. Furthermore, she was unable to detect even the removal of the cell itself, and proceeded to plaster the bare spot where it had been, even as if it were there.

Likewise, the familiar Sphex wasp, one of the most highly skilled huntresses of the insect world, knows exactly what species to capture for her future babies, where to sting them so as to produce paralysis instead of death—meat preservation without salt or cold storage—but she seems to display utter stupidity at times. It is her practice to leave her cricket at the entrance while she goes below to see that all is well before she takes it down. Forty times Fabre moved the cricket back from the entrance no more than six inches. Forty times Mrs. Sphex dragged it up to the entrance again, going down each time for another needless inspection.

Some species of Bembex (see Color Plate X) wasps do not provision their burrows, but bring the prey to their young as they need food, after the fashion of the birds. The entrance to their burrows is always in the sand. After getting down a little distance in more substantial soil, the gallery runs approximately parallel to the surface. On the surface there is no mark by which even a Fabre can detect the entrance.

Whether Mother Bembex comes in or goes out, the door of sand always closes behind her. She wanders far in search of prey, but always finds her doorpost as easily and definitely as if it were so plain that those who run might see it. Yet if one excavates the gallery, leaving the entrance intact, she will go through the door, come out of the open gallery, go through the door again, and repeat the performance again and again. At the end of the gallery lies the grub that was the object of her maternal solicitude, the baby for whom she worked day in and day out. She does not recognize it now. She tramples upon it, ignores its presence as if it were only so much clay. It is not recognized for itself; she knows it only when it lies at the end of the gallery to which her doorway leads.

Even when the doorway is obliterated, with the gallery left intact, she recognizes neither the gallery nor the grub at its terminus. Her baby may starve before she will feed it, if either door or hallway is disturbed. She recognizes her offspring only as the grub that lies at the end of an undisturbed gallery leading from a door through which she passes.

COUNTLESS WONDER STORIES

One might wander indefinitely in the realms of insectdom, discovering at every step things that make the most blasé among us pause and ponder.

Parasitism, in which members of one species lay their eggs upon the bodies of other species, or even inject their living young into the bodies of other species; parthenogenesis, in which as many as 94 generations have been produced without the interposition or birth of a single male (page 3); ability to hibernate, in which some individuals have been known to sleep more than forty years and wake up—ten thousand wonder stories might be told of these strange creatures in whose lives is more romance than all the fiction writers in Christendom have been able to conjure up.

For a discussion of specific species and families of insects and their habitats, see pages 28 to 87.

INSECT RIVALS OF THE RAINBOW

IN THE accompanying text pages will be found, in more detail than was possible in the general story, some of the outstanding events in the lives of the insect families represented in the 24 accompanying Color Plates.

A large number of the species portrayed in color come from the Tropics. But family relationships endure beyond geographic boundaries and are more persistent than either color or cut of clothes. So, every brilliant tropical insect has its drab cousins and common family bonds in temperate lands.

The biographies deal broadly with the families and give details that apply to those members most familiar to man in everyday life.

CRICKETS, COCKROACHES, KATYDIDS, AND THEIR KIN

(Order *Orthoptera*)

Plates II and III

This order embraces six families, represented respectively by the short-horned grasshoppers, the crickets, the katydids, the walking sticks, the mantids, and the cockroaches. The individuals of the first three families sing and jump, while those of the latter three are mute and creep. Almost all of the music of the insect world comes from the three singing families of the *Orthoptera*. Indeed, the cicada is the one famous maestro that does not belong to this order.

Short-horned Grasshopper Family (*Acrididae*). The short-horned grasshopper family, distributed all over the world, has about 500 species in the United States. To it belong the Rocky Mountain locust, which in days gone by caused Kansas to be known as the "hopper" State, the Argentine locust, which frequently descends upon the pampa from the foothills of the Andes and eats everything bare before it, the locust that was among the Plagues of Pharaoh, and that other one which figured in the diet of "locusts and wild honey" mentioned in the Bible.

The life histories of most of the short-horned grasshopper and locust species show little variation. The females deposit their eggs in small oval, or bean-shaped packets, either in the soil, at the base of the stems of grasses, or in soft wood. The fall-deposited eggs do not hatch until spring.

The species reproduced are: Autumn Yellow Winged Grasshopper (*Arphia xanthoptera* Burm. Plate II, figure 1), occurring in the northeastern United States in autumn; African Grasshopper (*Atractomorpha aberrans* Karsch. Plate II, figure 2), coming from central Africa; Eastern Lubber Grasshopper (*Romalea microptera* Palis. Plate II, figure 6), occurring in the hay fields of southeastern United States; Yellow Winged Grasshopper (*Arphia simplex* Scudd. Plate III, figure 2), habitat the Mississippi Valley; European Grasshopper (*Monachidium lunus* Joh. Plate III, figure 4), occurring alike in Europe, Asia, and Africa; Desert Grasshopper (*Leprus cyaneus* Cockerell. Plate III, figure 6), habitat the arid areas of southwestern United States; Old World Migratory Locust (*Locusta migratoria* Linn. Plate III, figure 7), occurring in Europe.

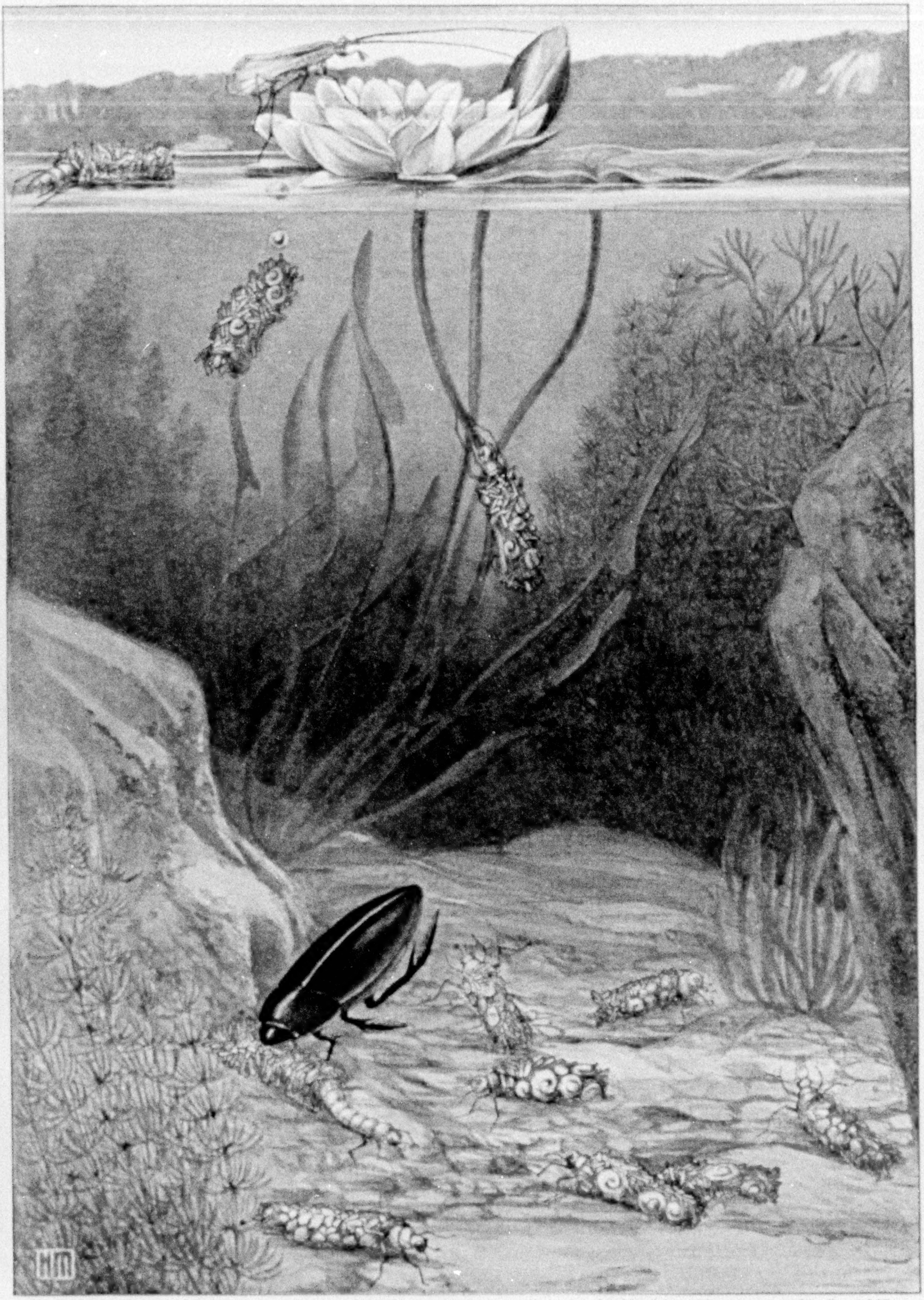
Walking Stick Family (*Phasmidae*). This bizarre group, some of whose members disguise themselves by simulating twigs and leaves, contains about 600 species, mainly tropical. Sixteen species are native American, the most familiar being the walking stick or devil's darning-needle. The eggs, one-eighth of an inch long, of polished black, with a whitish stripe on one side, are scattered on the ground in the fall, where they lie until the warm days of spring. The female, unlike most Orthopters, makes no provision for their safety. If certain species of walking sticks lose a leg another grows in its place.

The species reproduced is: Walking Leaf (*Pulchriphyllium bioculatum* Gray. Plate II, figure 3), habitat African coast.

Mantis Family (*Mantidae*). The mantids are a carnivorous tropical tribe, with many species, having wings resembling the leaves of plants, both in coloring and formation. Perhaps a score of species are found in the South, one of them extending its habitat as far north as Maryland and Indiana. The egg cases approximate the size and shape of an almond, and the color of golden grain, the substance of which they are made being akin to silk—a frothy mass whipped until it turns to a foam and hardens.

It has been remarked that although the attitude the mantis assumes may seem to be that of devotion, such sanctimonious airs are a mask of evil habits; "those arms folded in prayer are cutthroat weapons; they tell no beads, they slay whatever passes within range." At the sight of one of the more formidable kinds of prey the mantis gives a convulsive shiver, strikes a terrifying pose, spreads its wings, curls the tip of its abdomen, and, standing firmly on four hind legs, holds the forward part of its body upright, with forelegs forming a cross. The victim comes within range, the forelegs fall, the claws strike, and the saws clutch the prey. The wretched victim writhes with pain, chews space with its mandibles, and helplessly kicks the air. The mantids are friends of man because they live so largely on insects that are destructive to crops (see, also, page 20).

The species reproduced is: Chinese Mantis (*Tenodera sinensis* Sauss. Plate II, figure 4), an immigrant from China.



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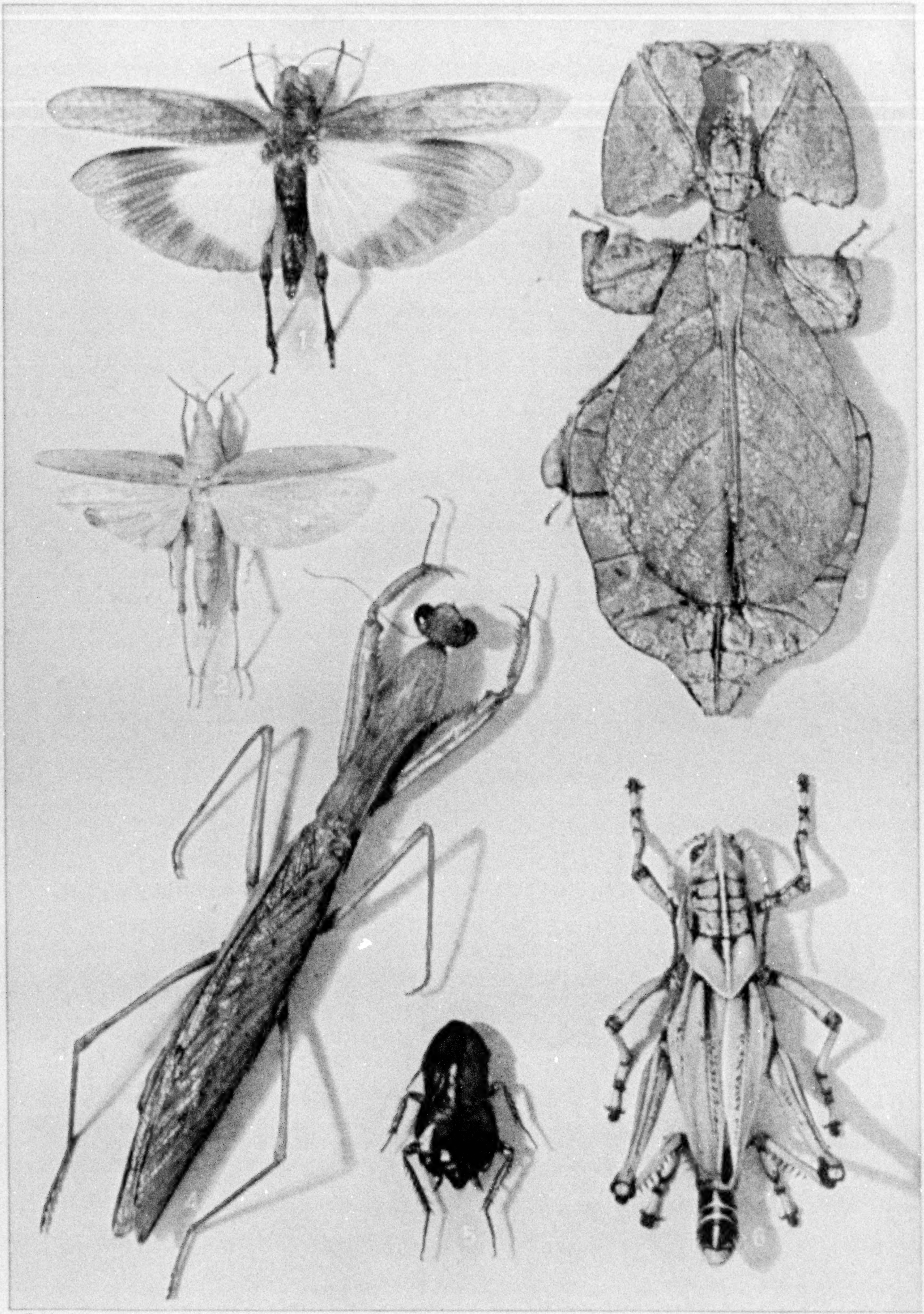
SURPRISING EVENTS IN THE LIVES OF CADDIS-FLIES

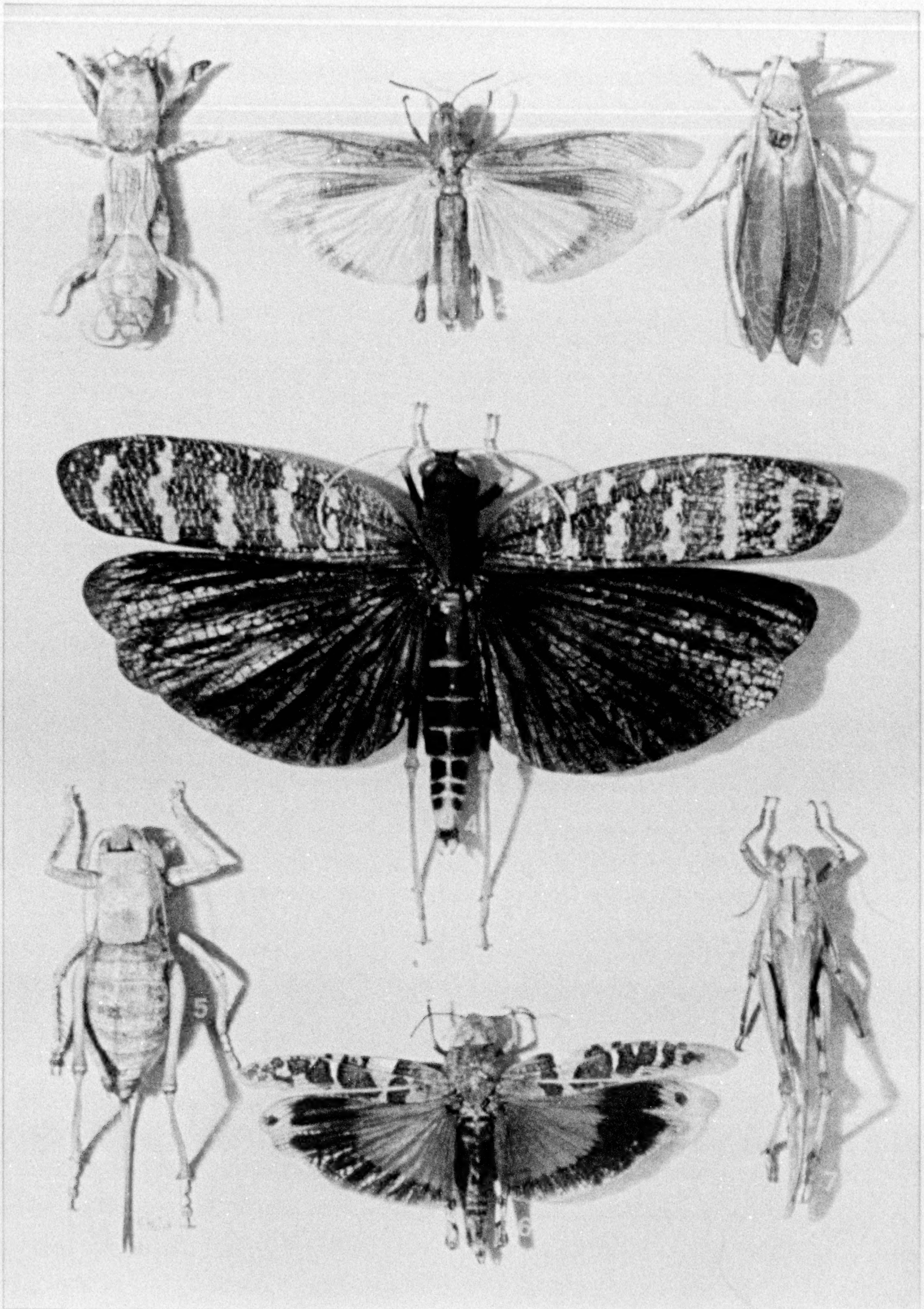
Airy mannered, filmy winged, and long antennaed, one would hardly suspect the gentle creature perched on the lily as being the mother of the insectean inventor of the first submarine. She drops her eggs on the river bottom. These hatch, and the little wigglers build themselves cases of fiber and pebbles, which they line with silk. In these they can rise or sink at will. The diving beetle preys upon them as shown. The caddis-fly illustrated belongs to the family *Limnophilidae*, and the diving beetle to the family *Hydrophilidae*. The insects illustrated are natural size.



© National Geographic Society Natural Size

A GROUP OF GRASSHOPPERS AND THEIR CONTRASTING KIN

(1) Autumn Yellow Winged Grasshopper, *Arphia xanthoptera* Burm. [Female]; (2) African Grasshopper, *Atractomorpha aberrans* Karsch [Female]; (3) Walking Leaf, *Pulchriphyllium bioculatum* Gray [Female]; (4) Chinese Mantis, *Tenodera sinensis* Sauss. [Female]; (5) Oriental Cockroach, *Blatta orientalis* Linn. [Female]; (6) Eastern Lubber Grasshopper, *Romalea microptera* Palis. [Male]. See text under the following Family headings: Short-horned Grasshopper, Walking Stick, and Mantis.



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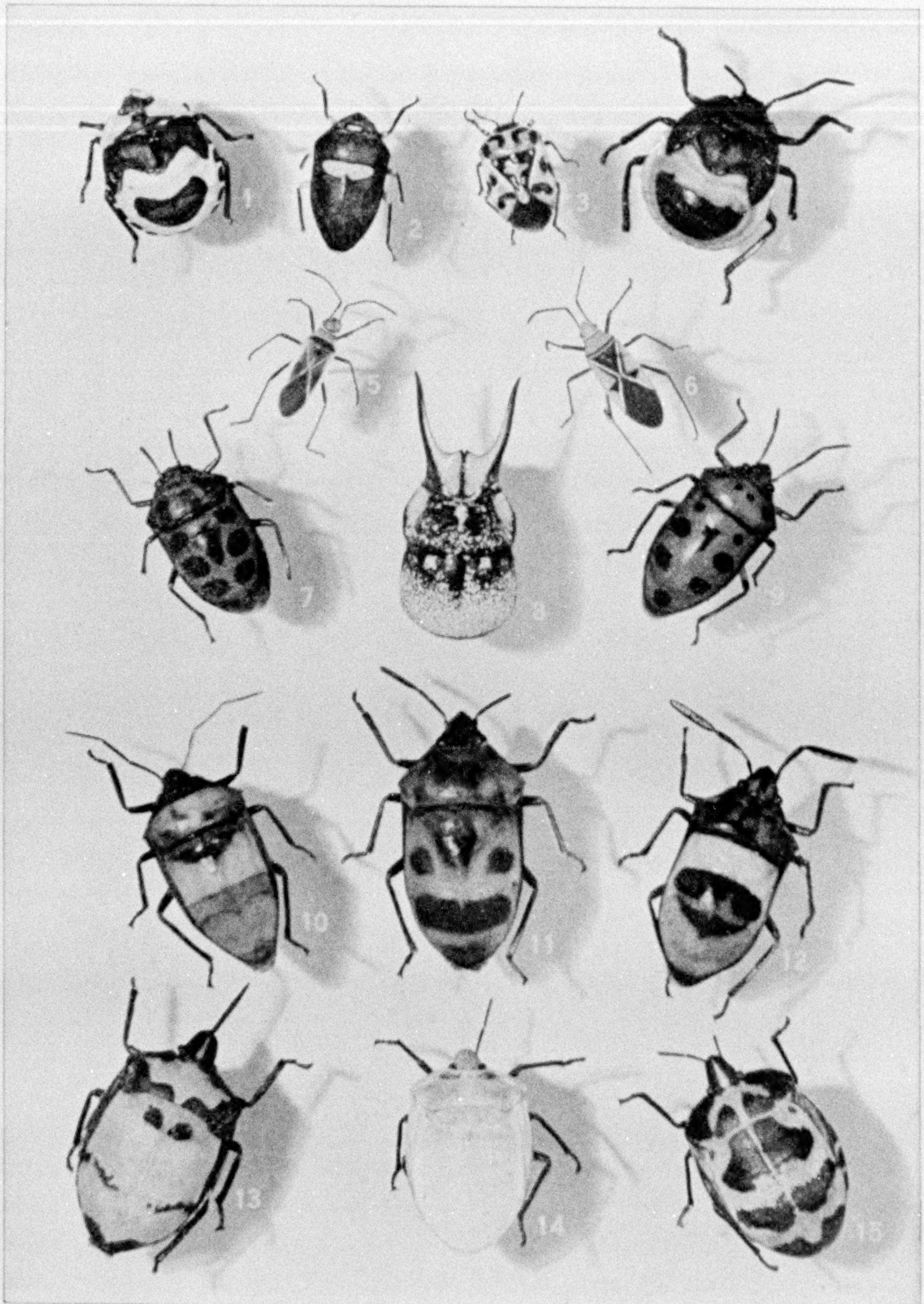
Natural Size

THE MOLE-CRICKET, THE TRUE KATYDID, AND SOME OF THEIR COUSINS

(1) European Mole-cricket, *Gryllotalpa gryllotalpa* Linn. [Female]; (2) Yellow Winged Grasshopper, *Arphia simplex* Scudd. [Female]; (3) True Katydid, *Pterophylla camellifolia* Fab. [Male]; (4) European Grasshopper, *Monachidium lunus* Joh. [Female]; (5) Mormon Cricket, *Anabrus simplex* Hald. [Female]; (6) Desert Grasshopper, *Leprus cyaneus* Cockerell [Female]; (7) Old World Migratory Locust, *Locusta migratoria* Linn. [Male]. See text under the following Family headings: Cockroach, Cricket, and Long-horned Grasshopper.



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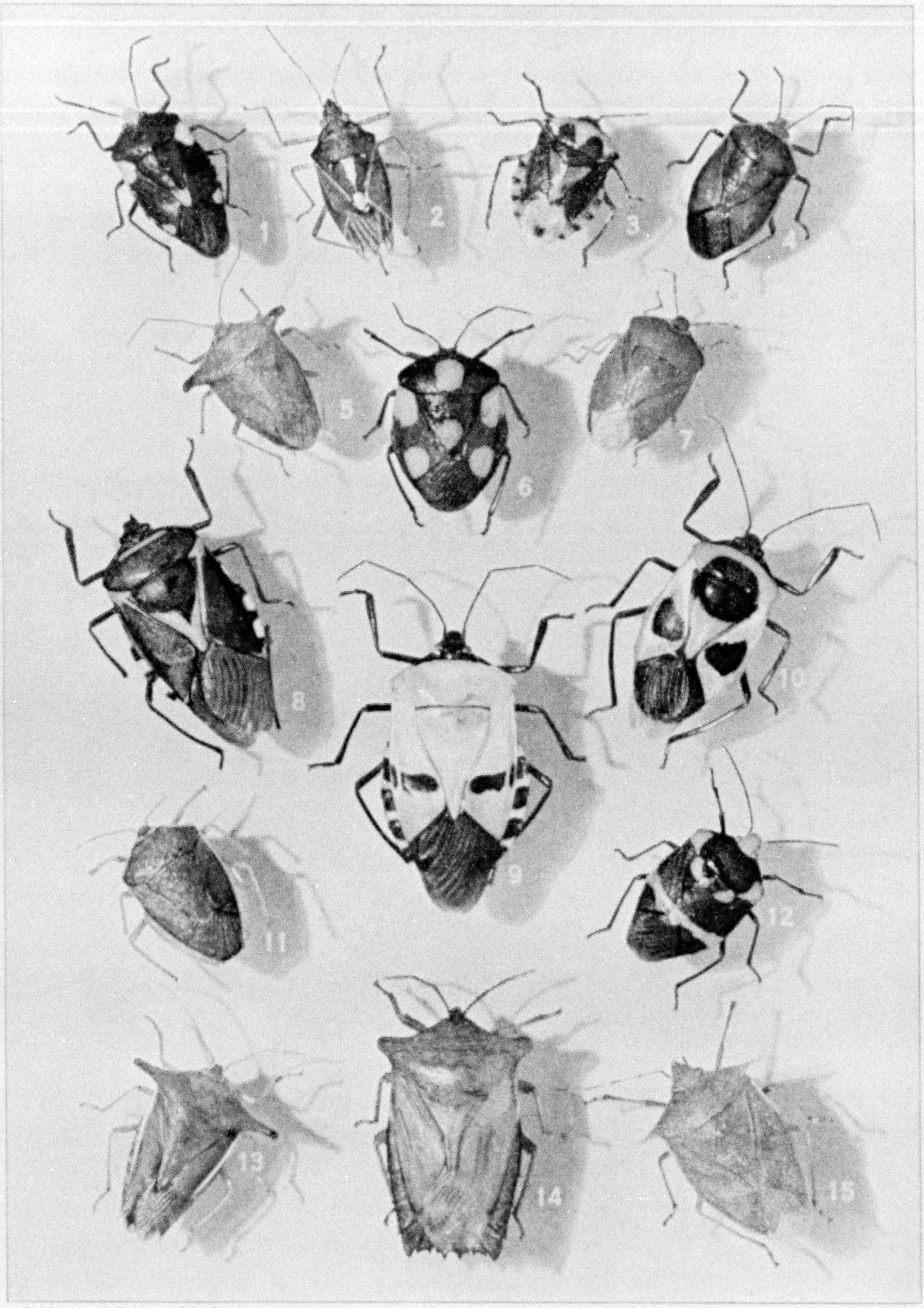
1⅛ times Natural Size

A PLATE OP HEMIPTEROUS JEWELS GATHERED FROM THE ENDS OF THE EARTH

(1) Nymph of *Poecilocoris druraei* Linn.; (2) *Philia senator* Fab. [Female]; (3) Harlequin Cabbage-bug, *Murgantia histrionica* Hahn [Female]; (4) Nymph of *Poecilocoris nepalensis* H-S.; (5) *Dysdercus mimus* Say [Male]; (6) *Dysdercus andreae* Linn. [Male]; (7) *Chrysocoris bilunulatus* Vollen. [Female]; (8) *Ceratocoris bucephalus* White [Male]; (9) *Calliphara nobilis* Linn. [Female]; (10) *Calliphara excellens* Burm. [Female]; (11) *Chrysocoris grandis* Thumb. [Female]; (12) *Chrysocoris sellatus* White [Female]; (13) *Tectocoris diopthalmus* var. *schonherri* Esch. [Female]; (14) *Tectocoris diopthalmus* var. *cyanipes* Fab. [Female]; (15) *Tectocoris peregrina* Kirk. [Female]. See text under the following Family headings: Shield-bug, Stink-bug, Cotton-stainer, and Burrowing-bug.



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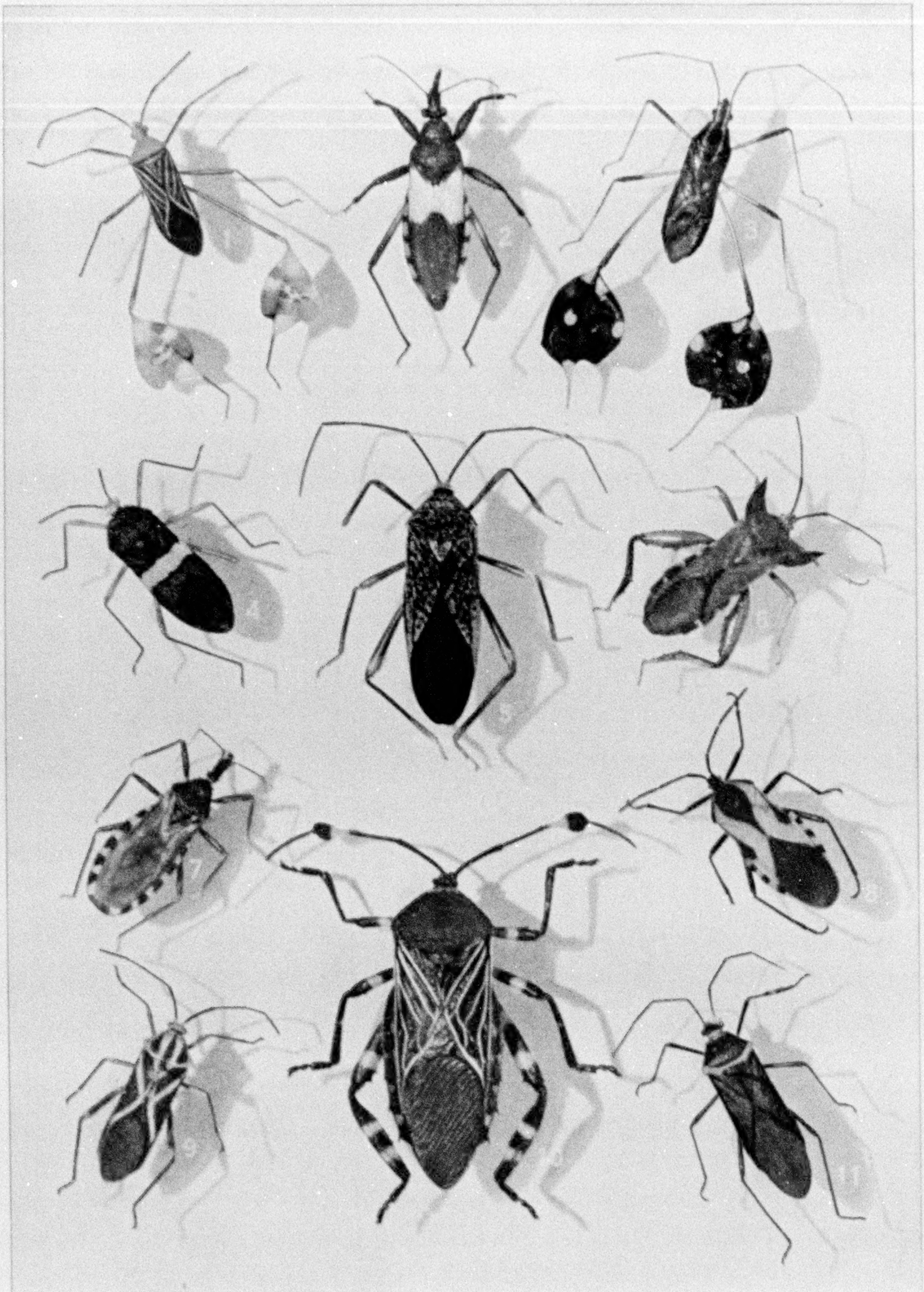
Natural Size

SOME BEAUTIFUL MEMBERS OF AN ODOROUS CLAN—THE STINK-BUGS

(1) *Arocera elongata* Uhler [Female]; (2) *Dalpada oculata* Fab. [Female]; (3) *Vulsirea violacea* Fab. [Female]; (4) *Arocera splendens* Blanch. [Male]; (5) *Edessa haedina* Stal. [Male]; (6) *Brachystethus rubromaculatus* Dallas [Female]; (7) *Nezara hilaris* Say [Female]; (8) *Chalcocoris rutilans* Stoll [Male]; (9) *Catacanthus incarnatus* Drury [Female]; (10) *Catacanthus carrenoi* LeGuill. [Female]; (11) *Edessa rufomarginata* DeGeer. [Male]; (12) *Pharypia pulchella* Stoll [Female]; (13) *Edessa cervus* Stoll [Female]; (14) *Pygoplatys longiceps* Stal. [Female]; (15) *Loxa variegata* Dist. [Male]. See text under the heading of Stink-bug Family.



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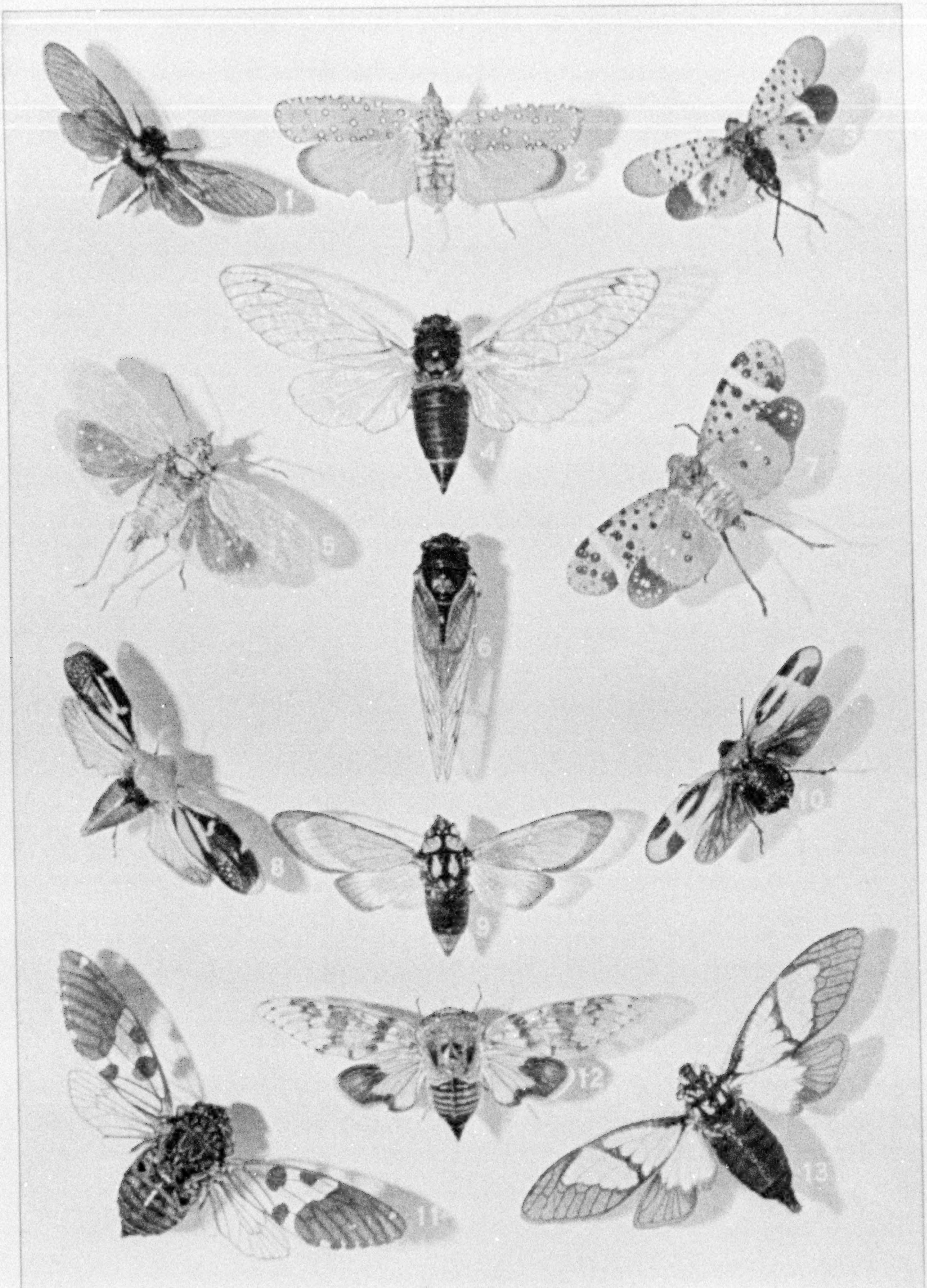
Natural Size

ASSASSIN-BUGS AND SQUASH-BUGS THAT BELIE THEIR NAMES

(1) *Anisosceles hymeniphera* Westwood [Female]; (2) *Microtomus purcis* Drury [Male]; (3) *Diactor bilineatus* Fab. [Male]; (4) *Paryphes laetus* Fab. [Female]; (5) *Mictis metallica* Sign. [Female]; (6) *Mozena lunata* Burm. [Male]; (7) *Triatoma infestans* Klug [Male]; (8) *Sephina vinula* Stal. [Male]; (9) *Machtima mexicana* Stal. [Female]; (10) *Thasus gigas* Burm. [Male]; (11) *Sphictyrtus longirostris* Dist. [Female]. See text under the following Family headings: Squash-bug and Assassin-bug. To the Assassin-bug Family belong two species which figured prominently in the news of several decades ago. They were called the kissing bugs and their reputation spread so far and wide that wherever anyone was bitten by an insect of any kind the inference was that he or she had been the victim of an attack by one of the Assassins.



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Natural Size

THE SEVENTEEN-YEAR LOCUST, WITH OTHER CICADAS AND LANTERN-FLIES

(1) Malayan Cicada, *Huechys phoenicura* Germ. [Female]; (2) Indian Lantern-fly, *Saiva cardinalis* Butl. [Male]; (3) Asiatic Lantern-fly, *Lycorma delicatula* White [Male]; (4) Seventeen-year Locust, *Tibicina septendecim* Linn. [Female]; (5) Mexican Lantern-fly, *Enchophora stillifer* Stal. [Male]; (6) Same as Figure 4; (7) Philippine Lantern-fly, *Aphana astraea* Stal. [Male]; (8) Philippine Frog-hopper, *Gynopygoplax theora* White [Female]; (9) Brazilian Cicada, *Carineta formosa* Germ. [Male]; (10) Brazilian Frog-hopper, *Tomaspis furcata* Germ. [Female]; (11) Mexican Cicada, *Zammara calochroma* Walk. [Male]; (12) Javanese Cicada, *Platypleura fulvigera* Walk. [Female]; (13) Indian Cicada, *Gaeana sulphurea* Hope [Male]. See text under the following Family headings; Cicada, Lantern-fly, and Frog-hopper.

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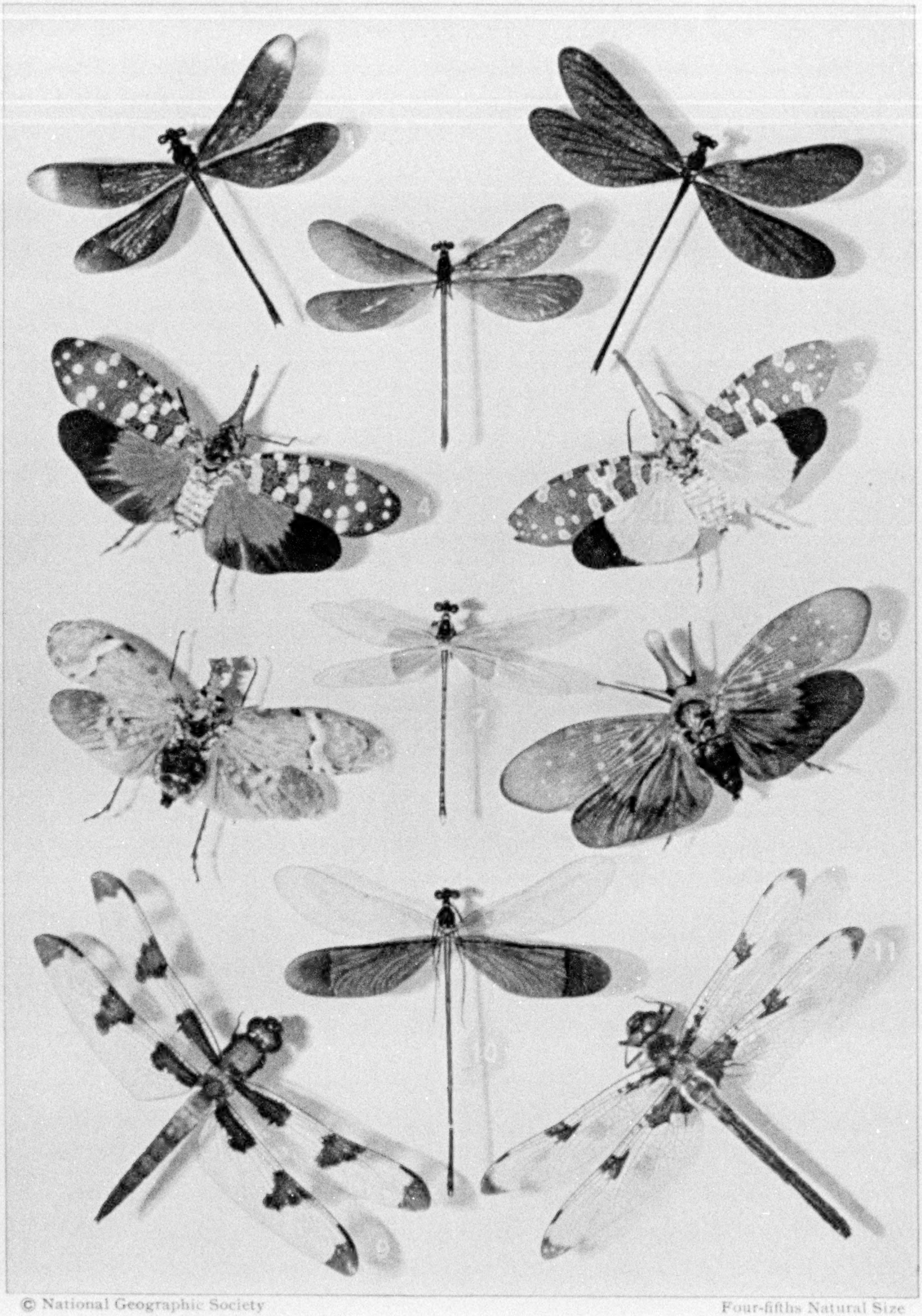

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Four-fifths Natural Size

ANIMATED PURSUIT PLANES AND WINGED CLOWNS OF THE INSECT WORLD

(1) Philippine Damsel-fly, *Pseudophaea refulgens* Selys; (2) Black-wing Damsel-fly, *Agrion maculatum* Beauv.; (3) *Vestalis melania* Selys; (4) *Fulgora maculata* Olivier [Male]; (5) Chinese Candle Fly, *Fulgora candelaria* Fab. [Male]; (6) Panama Lantern-fly, *Phrictus tripunctata* Dist. [Male]; (7) Ruby-spot, *Hetaerina americana* Fab. [Male]; (8) Duck Billed Lantern-fly, *Fulgora samarana* Baker [Female]; (9) Ten Spot Skimmer, *Libellula pulchella* Drury; (10) *Neurobasis chinensis* Linn.; (11) Water-prince, *Epicordulia princeps* Hagen. The pursuit planes belong to the Dragon-fly and True Damsel-fly Families and the clowns to the Lantern-fly Family. See text under these Family headings.

Cockroach Family (*Blattidae*). Though a thousand species of cockroaches have been described, most of them inhabit tropical countries; only 43 exist north of the Rio Grande River, these usually being found in fields and woods under sticks, stones, and other rubbish. The two major pests are the Oriental Cockroach and the croton bug, both of which came from foreign parts, the former from China and the latter from Europe. Tramp steamers sometimes come into port, after sailing the seven seas, with their sailors wearing gloves when asleep, to save the nails of their hands from being gnawed off by the cockroaches.

Almost any sort of dry organic matter—paste from bookbindings or wall paper, dry bread or leather scrapings, the products of milady's larder or their own egg cases—is "beer and skittles" to the cockroach palate.

The female lays her eggs in a purselike, brown case of horny material, usually about 16 eggs in two rows, arranged so that when the young hatch, each rank will face the other. The mother cockroach, as a rule, carries the egg case with her until the babies are ready to emerge, when she assists them by tearing it open. The young ones are able, as soon as they hatch, to go about without asking odds from anybody, eating the same food as their elders enjoy. They mature in about a year, casting off a number of outgrown suits before becoming adults.

The species reproduced is: Oriental Cockroach (*Blatta orientalis* Linn. Plate II, figure 5), found in many countries.

Cricket Family (*Gryllidae*). Most of the true crickets, which belong to the Gryllid family, have developed a fondness for living close to man, and the cheery calls of the Gryllid Romeos to their Juliets are familiar sounds. They are omnivorous eaters, most species spending the day in some dark cranny and going abroad to seek their prey at night. Some species are day hunters, however. The mole-cricket leads a burrowing life, usually in damp earth. The female deposits from 200 to 300 eggs in masses of from 40 to 60. She is one of the few nonsocial insects that look after their eggs until they hatch and then feed their young until the latter are able to shift for themselves. She has to keep a sharp eye on Mr. Mole-cricket, for he does not hesitate to eat his own children when he can get hold of them.

The species reproduced is: European Mole-cricket (*Gryllotalpa gryllotalpa* Linn. Plate III, figure 1), introduced into the United States from the Old World.

Long-horned Grasshopper Family (*Tettigoniidae*). Most of the older authorities call this family the *Locustidae*. It embraces the katydids, the meadow grasshoppers, the camel crickets, the sword bearing crickets, the western crickets, and the Jerusalem crickets.

The species reproduced are: True Katydid (*Pterophylla camellifolia* Fab. Plate III, figure 3), occurring in eastern United States; Mormon Cricket (*Anabrus simplex* Hald. Plate III, figure 5), habitat western United States.

THE BUGS AND CICADAS AND THEIR RELATIVES

(Order *Hemiptera*)

Plates IV to VIII

This order is one of the most versatile in habit and form. While many recent authorities subdivide it into several groups, the more conservative older classification is used by many museums.

The group embraces about 5,000 American species, including plant-lice, scale-insects, and mealy wings; cicadas, lantern-flies, tree- and leaf-hoppers, and spittle-insects; water- boatmen, striders, and scorpions; ambush-bugs, assassin-bugs, stink-bugs, and many others.

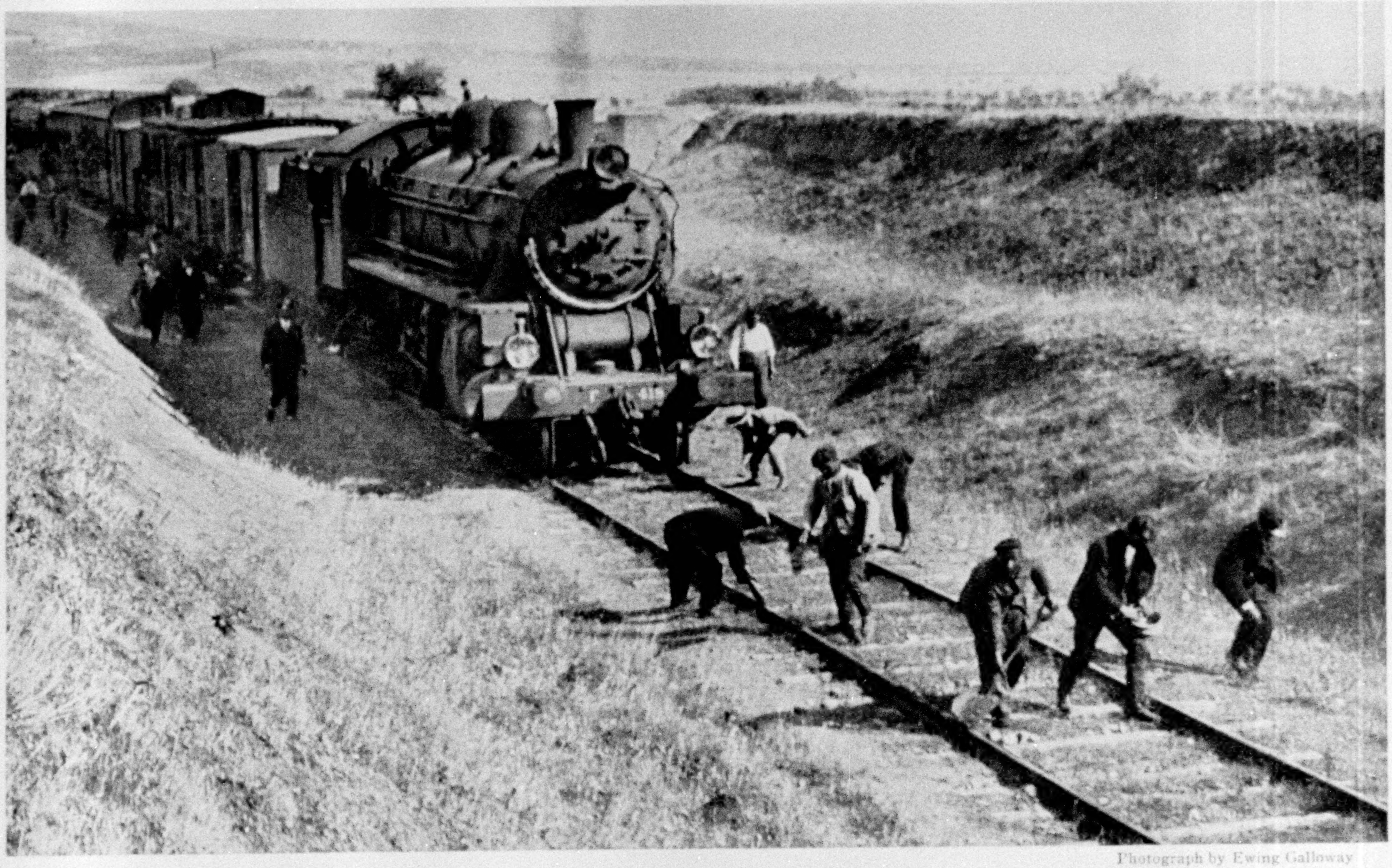
Some of the remarkable families not shown because of the minuteness of their members are those which produce plant galls. Typical of these are the sucking bugs of the plant-louse type, which produce the twig gall of the hickory and the root gall of the grape. Another is the family to which belongs the San José scale. The males of some species of this family are mouthless and so have a very brief existence. The females become both footless and blind after settling down.

Statisticians have estimated that leaf-hoppers, by sucking the sap, probably destroy one-fourth of all the grass that grows and that a million of them will kill as much forage as a cow can eat.

Shield-bug Family (*Scutelleridae*). The shield-bugs constitute an attractive clan, of which some 25 American species have been described. None of the latter occurs in sufficient numbers to be of economic importance.

The species reproduced are: Nymph of *Poecilocoris druraei* Linn. (Plate IV, figure 1), occurring in India and China; *Philia senator* Fab. (Plate IV, figure 2), occurring in Australia and Malaysia; Nymph of *Poecilocoris nepalensis* H-S. (Plate IV, figure 4), occurring in India and China; *Chrysocoris bilunulatus* Vollen. (Plate IV, figure 7), a native of Sumatra; *Calliphara nobilis* Linn. (Plate IV, figure 9), habitat southeastern Asia; *Calliphara excellens* Burm. (Plate IV, figure 10), occurring in southeastern Asia; *Chrysocoris grandis* Thumb. (Plate IV, figure 11), habitat China, Japan, and India; *Chrysocoris sellatus* White. (Plate IV, figure 12), a native of the Philippines; *Tectocoris diopthalmus* var. *schonherri* Esch. (Plate IV, figure 13), habitat extending from the coast of China to that of Australia; *Tectocoris diopthalmus* var. *cyanipes* Fab. (Plate IV, figure 14), a native of Java; *Tectocoris peregrina* Kirk. (Plate IV, figure 15), inhabiting the lands that border the Indian Ocean.

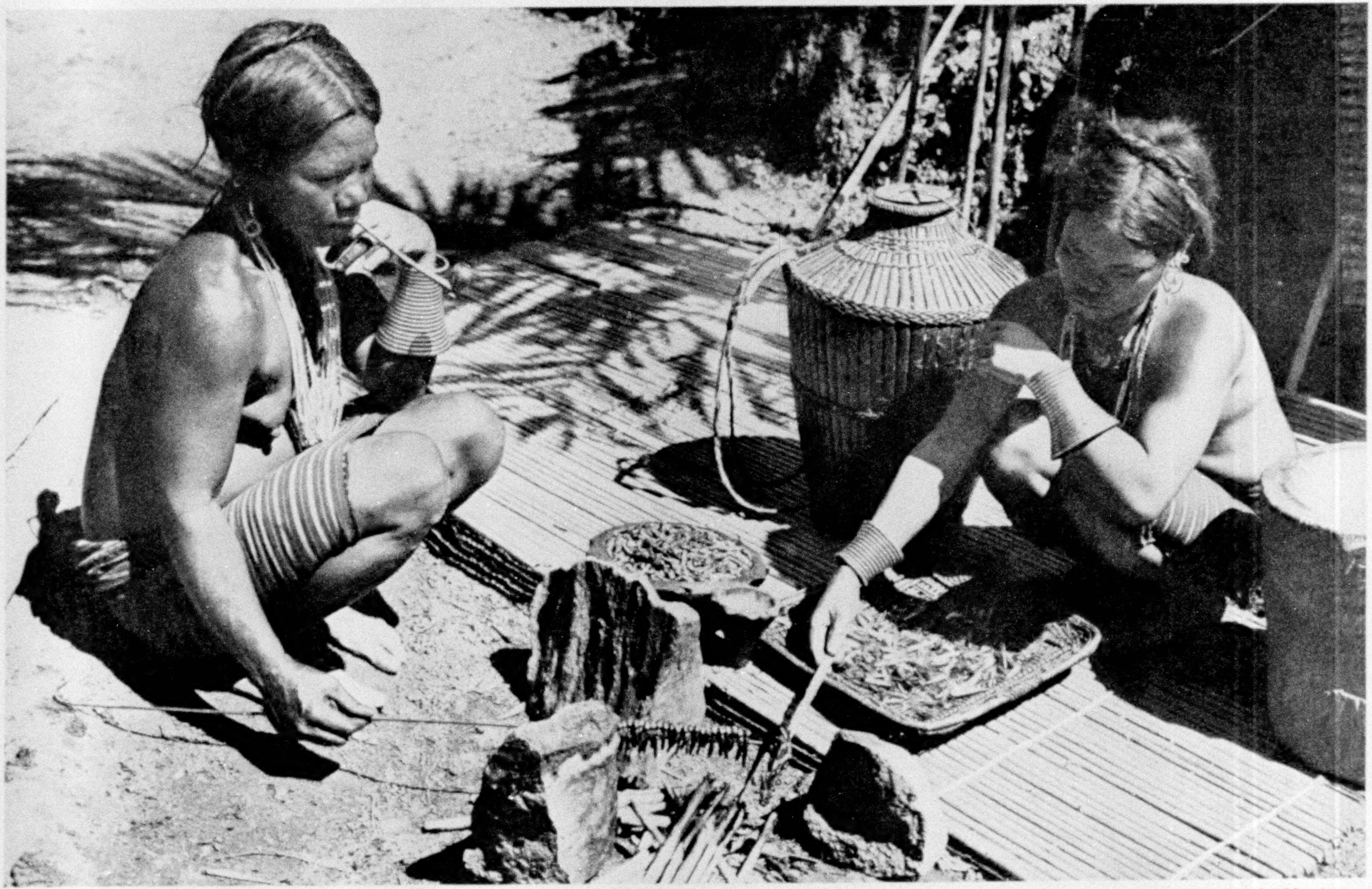
Stink-bug Family (*Pentatomidae*). This family comprises some 4,000 species, about 300 occurring in the United States. Most species



Photograph by Ewing Galloway

LOCUSTS HOLD UP A FREIGHT TRAIN ON THE ATHENS-SALONIKI LINE

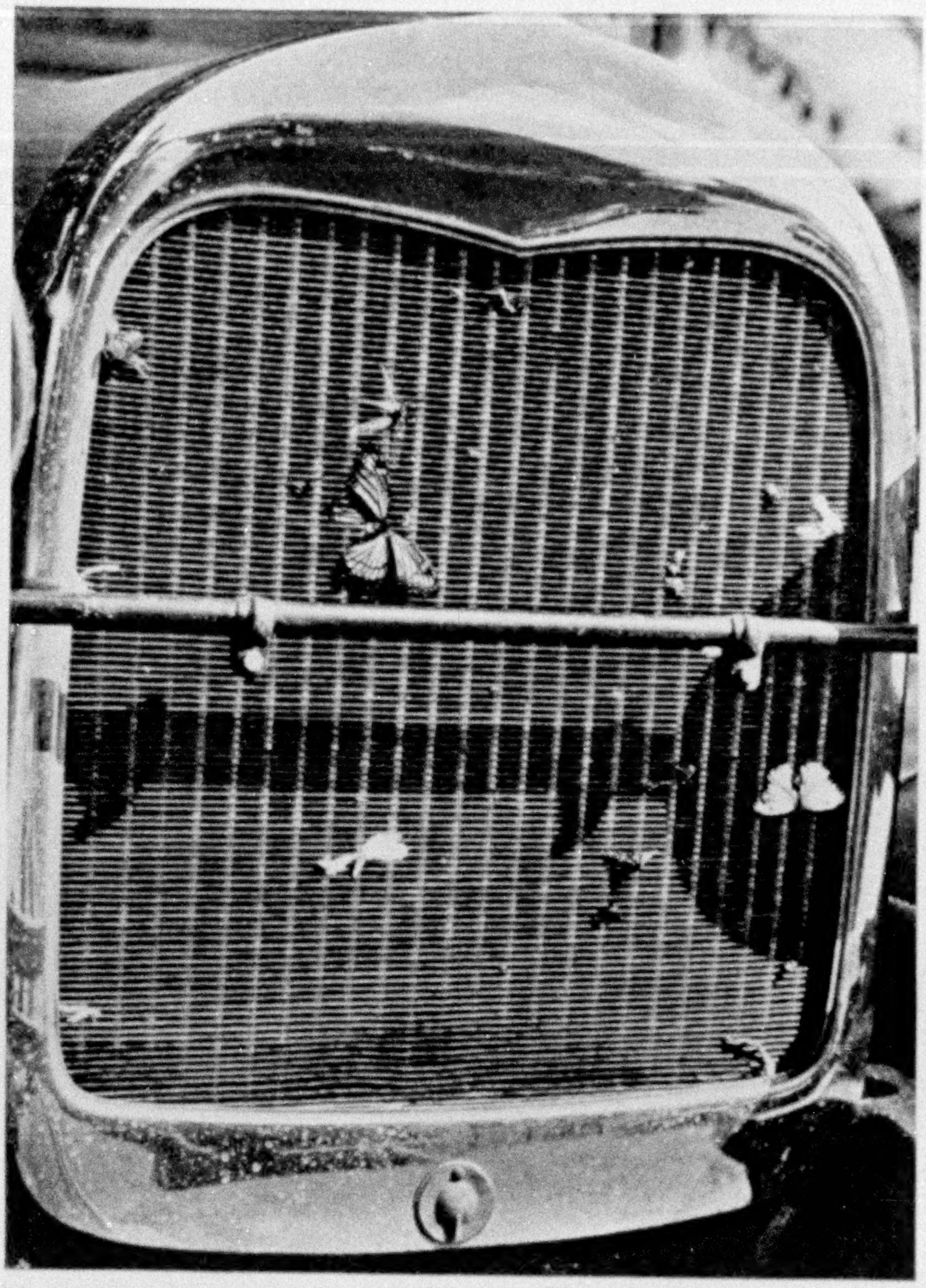
The locusts that plagued Egypt in Bible times, the ones that figure periodically in the devastation of Palestine, those that made Kansas the "hopper" State some decades ago, and those which from time to time descend on the Argentine pampa and transform luxuriant vegetation into a desert waste, are all of a pattern. They belong to the short-horned grasshopper family. A train cannot get traction on rails that have been "soaped" with the crushed bodies of these insects.



Photograph by Charles Martin

LOCUSTS AND WILD HONEY STILL REMAIN FOOD ITEMS AMONG PRIMITIVE PEOPLE

Ifugao women in Luzon, Philippine Islands, prepare locusts for food by roasting them. Such rich feasts often cause indigestion. According to Mosaic law (Leviticus 11, 22), the Children of Israel were permitted to eat "the locust after his kind, and the beetle after his kind, and the grasshopper after his kind." Flies and fly eggs are made into cakes by some Indian tribes in Mexico, and some species of beetles are used to put more "kick" in certain types of alcoholic beverages drunk by other tribes in the same country (see text, page 9).



Photograph by Clifton Adams

AN ILLUSTRATION OF ONE OF THE MEANS BY WHICH INJURIOUS INSECTS MAY BE DISTRIBUTED BY MAN UNWITTINGLY

Several insects occurring in south Florida caught in the radiator of an automobile. Some flew into the path of the car and some were drawn in by the draft of the motor-cooling fan.

are plant feeders, but not a few are omnivorous. Several of the more common American stink-bugs are green, like the large green tree bug and the bound tree bug; other common species are brown.

A few of the American species are as bizarre in their dress as a clown, and it is this character of its coat that gives to one of our worst pests, the Harlequin Cabbage-bug, its everyday name. That insect also might be regarded as the beer bug, for its eggs, neatly arranged in groups of twelve, six in a row, look like a group of miniature beer kegs, even down to the hoops and the bung.

The species reproduced are: Harlequin Cabbage-bug (*Murgantia histrionica* Hahn. Plate IV, figure 3), habitat United States; *Arocera elongata* Uhler. (Plate V, figure 1), habitat Brazil; *Dalpada oculata* Fab. (Plate V, figure 2), occurring in India, China, and Japan; *Vulsirea violacea* Fab. (Plate V, figure 3), ranging from Mexico to Brazil; *Arocera splendens* Blanch. (Plate V, figure 4), native of Central America and the northern part of South America; *Edessa haedina* Stal. (Plate V, figure 5), native of Mexico; *Brachystethus rubromaculatus* Dallas. (Plate V, figure 6), inhabiting Central America and Mexico; *Nezara hilaris* Say. (Plate V, figure 7), occurring in the United States; *Chalcocoris rutilans* Stoll. (Plate V, figure 8), habitat Africa; *Catacanthus incarnatus* Drury. (Plate V, figure 9), occurring in Japan, China, and Borneo; *Catacanthus carrenoi LeGuill.* (Plate V, figure 10), a native of the Philippines; *Edessa rufomarginata* DeGeer. (Plate V, figure 11), ranging from Mexico to the Argentine; *Pharypia pulchella* Stoll. (Plate V, figure 12), ranging from Mexico south to Brazil; *Edessa cervus* Stoll. (Plate V, figure 13), habitat Brazil to northern South America; *Pygoplatys longiceps* Stal. (Plate V, figure 14), occurring in the Philippines; *Loxa variegata* Dist. (Plate V, figure 15), occurring in Costa Rica and Panama.

Cotton-stainer Family (*Pyrrhocoridae*). This family is represented in our fauna by 22 species, which sometimes are known as red-bugs. The cotton-stainers do much damage by piercing cotton stems and bolls with their beaks and sucking the sap. Their principal damage, however, comes from the staining of the cotton in its open boll by the insects' excretions. Some species attack oranges, puncturing the skin and thereby causing the fruit to decay and fall to the ground.

The species reproduced are: *Dysdercus mimus* Say. (Plate IV, figure 5), occurring in the South; *Dysdercus andreae* Linn. (Plate IV, figure 6), occurring in Florida and the West Indies.

Burrowing-bug Family (*Cydnidae*). Twenty-nine species of this family now are listed in the United States. Their front legs are more or less flattened and fitted for digging, and they are found burrowing in sandy places and under sticks and stones. It is thought that they feed by sucking the sap from plant roots.

The species reproduced is: *Ceratocoris bucephalus* White. (Plate IV, figure 8), habitat southeastern Asia.

Squash-bug Family (*Coreidae*). This family consists of some 1,500 known species, of which 200 are American. The familiar squash-bug is its most widely known representative. To it also belong the box elder bug, which sucks the sap of the box elder and in adulthood resembles a giant bed-bug, and the cherry bug, which imbibes the juice of the cherry.

Some of the squash-bugs are queer-looking "critters." One has its wing cases higher at the sides than at the middle, thus producing a sort of hopper with a series of spines around the edge. In this the male has to carry the family eggs, but he accepts his task only after his spouse has henpecked him to a point where he sees that opposition is useless.

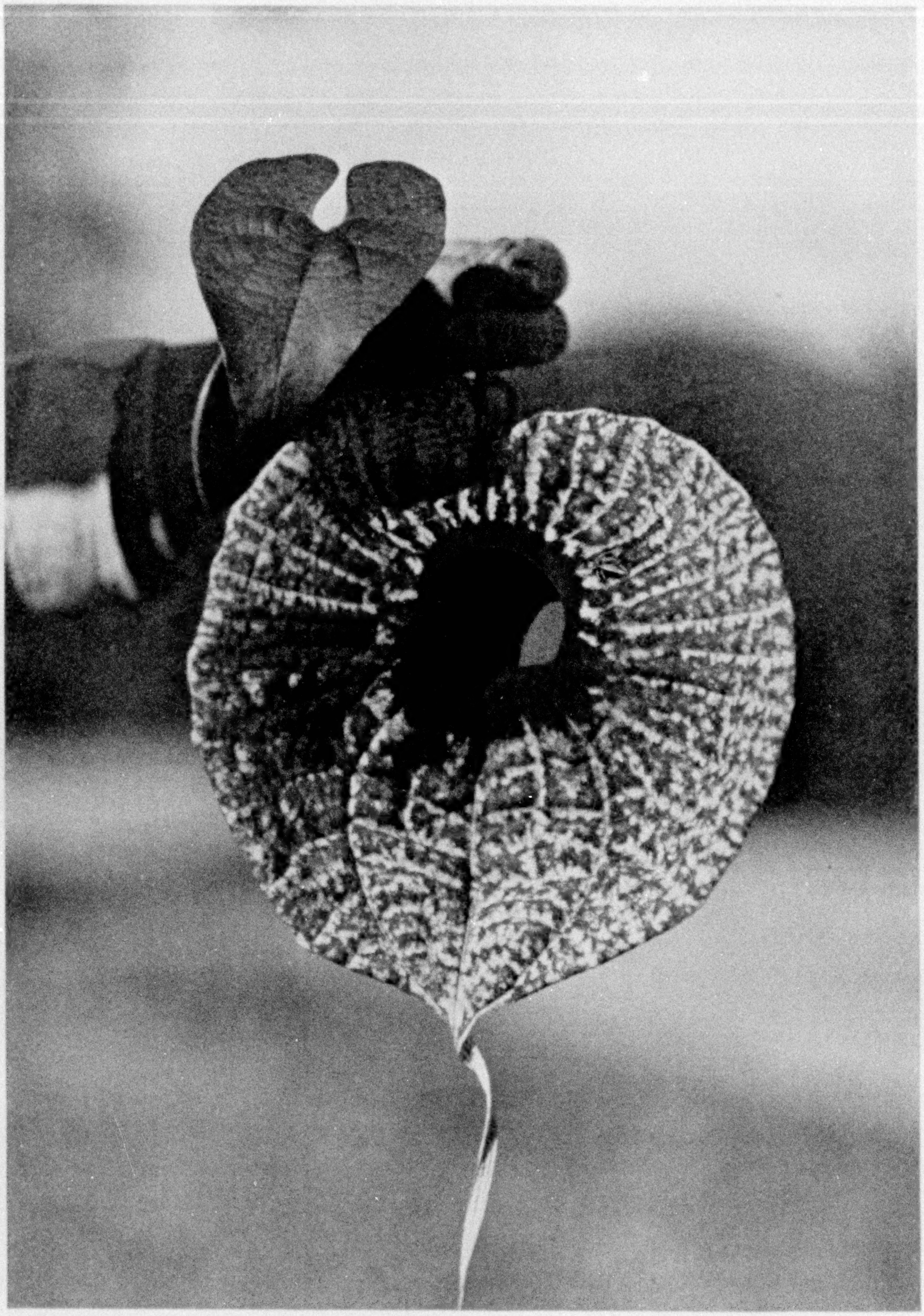
The species reproduced are: *Anisosceles hymeniphera* Westwood. (Plate VI, figure 1), found in Mexico; *Diactor bilineatus* Fab. (Plate VI, figure 3), inhabiting northern South America; *Paryphes laetus* Fab. (Plate VI, figure 4), occurring throughout South America; *Mictis metallica* Sign. (Plate VI, figure 5), native of Africa; *Mozena lunata* Burm. (Plate VI, figure 6), ranging from Texas to Central America; *Sephina vinula* Stal. (Plate VI, figure 8), inhabiting Mexico; *Machtima mexicana* Stal. (Plate VI, figure 9), habitat Mexico and Central America; *Thasus gigas* Burm. (Plate VI, figure 10), frequenting the southwestern part of the United States and Mexico; *Sphictyrtus longirostris* Dist. (Plate VI, figure 11), occurring in Central America.

Photograph by Charles Martin

AN IFUGAO LOCUST CATCHER WITH HIS NET, IN LUZON

Locusts sometimes swarm in unbelievable numbers. In 1889 a vast army of them spread out over an area of more than 2,000 square miles, while flying over the Red Sea. Cyprus reported an invasion in 1881 during which 1,300 tons of eggs alone were destroyed.

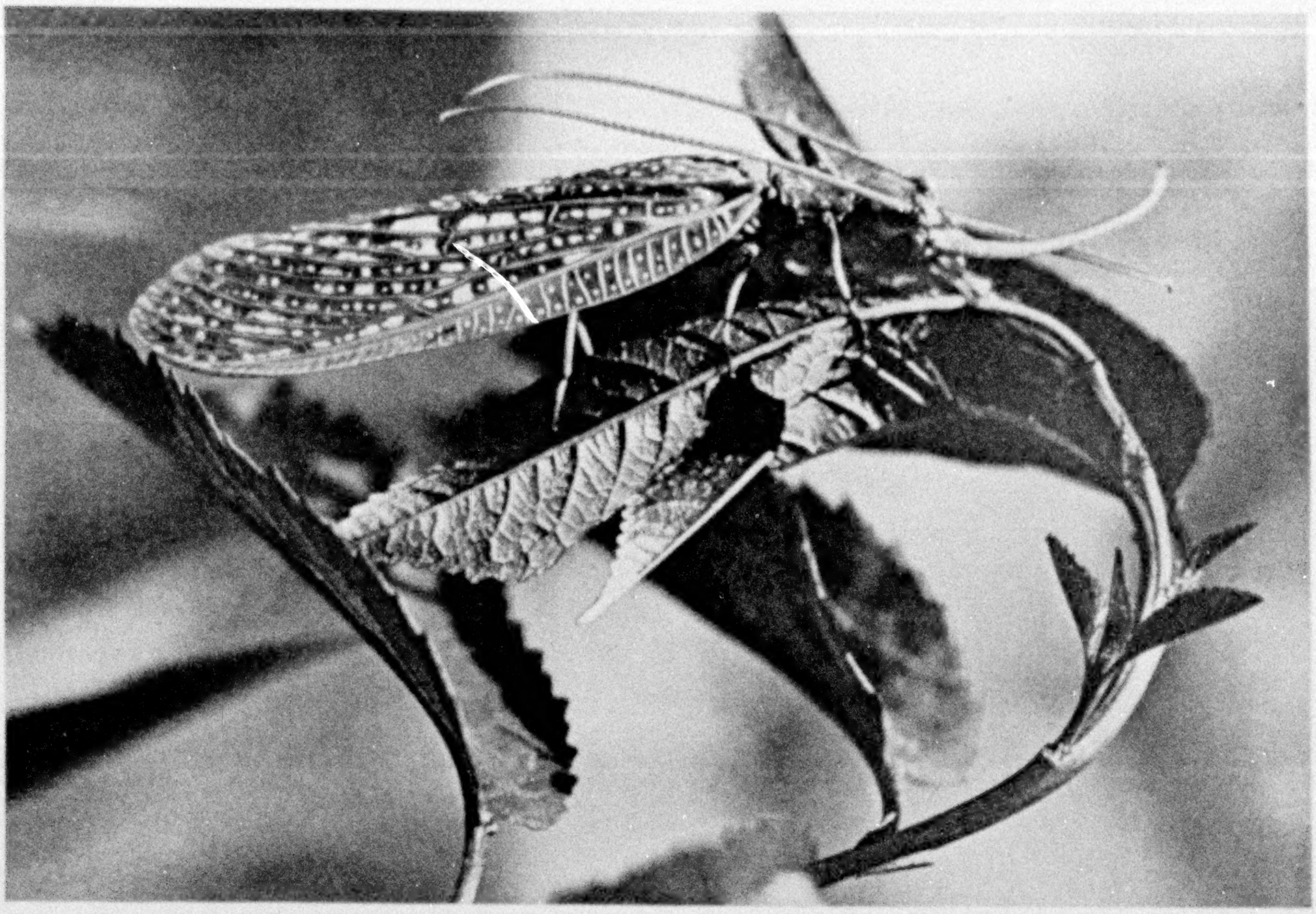
Assassin-bug Family (*Reduviidae*). This family, embracing some 2,000 species, most of them predaceous, feeds principally on the juices of other insects, draining the prey dry. To it belongs the famous kissing bug of yesteryear, whose young have coats of bristly, sticky hairs to which dust adheres, making a sort of mask from which its other name, masked bed-bug hunter, is derived. It is able to bite hard, inflicting a rather painful wound. Rarely, however, does it bite human beings unless attacked. Usually living out-of-doors, it sometimes invades vermin-haunted houses. In the South lives another member of the family known as the big bed-bug, which is a persistent sucker of human blood, and therefore is frequently rated as a kissing bug. The wheel-bug has a toothed



Photograph by James Dorsett

THE ARISTOLOCHIA FLOWER OF CEYLON DETAINS A FLY FOR ITS PURPOSES

The relationships between insects and flowers show many amazing adaptations. The Venus flytrap and the sundew are familiar flowers that capture flies. The aristolochia catches the fly (see on the inner rim at the right) and holds it a prisoner until the pollen carried on the insect's feet has fertilized the stigmas.



Photograph by Leonard Sefing

A HELLGRAMMITE FLY FINDS SAFETY IN MIMICRY

Before man ever dreamed of a World War, insects had come to be masters of the art of camouflage. Some of them employ fearsome aspects, others have acquired a low visibility, and still others imitate creatures that possess qualities distasteful to their natural enemies. The hellgrammite merges itself into its environment so that only sharp eyes detect its presence.

crest resembling a cock's comb on its thorax, and its eggs are shaped like little jugs, laid in masses of about 70.

The species reproduced are: *Microtomus purcis* Drury. (Plate VI, figure 2), inhabiting the southeastern United States; *Triatoma infestans* Klug. (Plate VI, figure 7), occurring in South America.

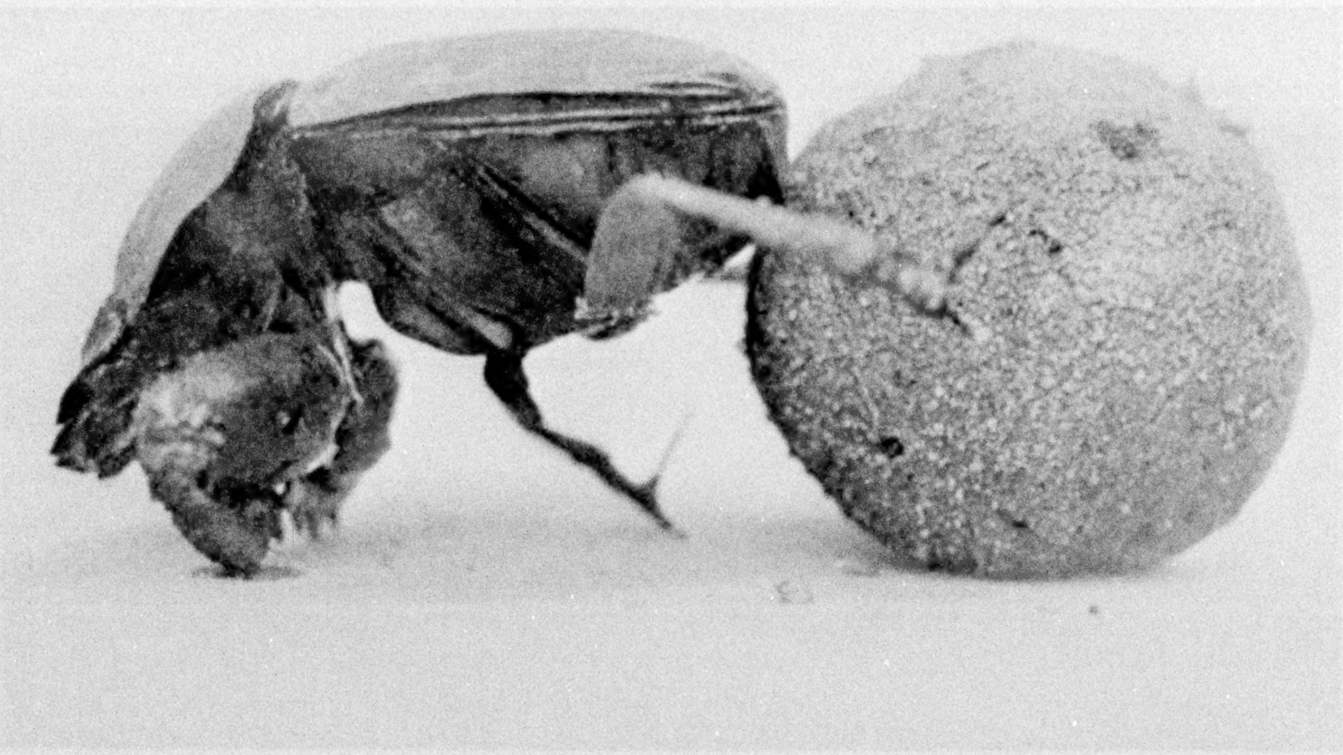
Cicada Family (*Cicadidae*). About 74 species of this family are found in our fauna, including the harvest-flies and lyremen. The most famous cicada, however, is the Seventeen-year Locust. Of all known insects it has the longest period of adolescence, spending 17 years under the ground in its larval stage and only a few weeks awing in its adult form.

Emerging from the ground after throwing off its larval clothes, it makes merry for a few days and then dies. In laying her eggs the female pierces the twigs of various trees, and in the slit thus made deposits them. These twigs later break and fall to the ground, and in about six weeks the young hatch and creep down beneath the surface to begin their long subterranean career. They feed on the humus in the soil and, to some extent, on the juices of the roots of trees and other deep-soil plants, and molt from four to six times during their underground life.

The species reproduced are: Malayan Cicada (*Huechys phoenicura* Germ. Plate VII, figure 1), occurring in the Malay Archipelago; Seventeen-year Locust (*Tibicina septendecim* Linn. Plate VII, figures 4 and 6), inhabiting the eastern United States; Brazilian Cicada (*Carineta formosa* Germ. Plate VII, figure 9), habitat Brazil; Mexican Cicada (*Zammara calochroma* Walk. Plate VII, figure 11), habitat Mexico and South America; Javanese Cicada (*Platypleura fulvigera* Walk. Plate VII, figure 12), habitat Malay Archipelago; Indian Cicada (*Gaeana sulphurea* Hope. Plate VII, figure 13), occurring in India.

Lantern-fly Family (*Fulgoridae*). While most of our lantern-flies are small, many of the tropical species are large and bizarre. Someone has said that their growth has gone to their heads. A Brazilian species looks something like an insectean hippopotamus, there being even the simulation of tusks on its dangerous-looking, but wholly innocent, head. Certain species of lantern-flies in China excrete large quantities of white, flocculent wax, which is used by the Chinese for candles and other purposes.

The species reproduced are: Indian Lantern-fly (*Saiva cardinalis* Butl. Plate VII, figure 2), living in India; Asiatic Lantern-fly (*Lycorma delicatula* White. Plate VII, figure 3),



Photograph by Will F. Taylor

A BEETLE OF THE BELGIAN CONGO ROLLING A BALL OF DUNG TO ITS NEST

This is a cousin of the famous sacred beetle of the ancient Egyptians, which was placed in the tombs with the dead, whose picture was painted on sarcophagi, and whose image was carved in stones and precious gems. The familiar rose beetle belongs to the same clan.

occurring in India and China; Mexican Lantern-fly (*Enchophora stillifer* Stal. Plate VII, figure 5), from Mexico and Central America; Philippine Lantern-fly (*Aphana astraea* Stal. Plate VII, figure 7), a native of the Philippines; *Fulgora maculata* Olivier. (Plate VIII, figure 4), inhabiting Ceylon and India; Chinese Candle Fly (*Fulgora candelaria* Fab. Plate VIII, figure 5), occurring in India and China; Panama Lantern-fly (*Phrictus tripunctata* Dist. Plate VIII, figure 6), habitat Panama; Duck Billed Lantern-fly (*Fulgora samarana* Baker. Plate VIII, figure 8), occurring in the Philippines.

Frog-hopper Family (*Cercopidae*). In rural strolls occasionally one sees small masses of froth adhering to the stems of taller grasses and weeds. This is a viscid fluid whipped into a heavy froth by an insect which gets its popular name, frog-hopper, from the belief that these masses are the spittle of tree frogs (see illustration, page 22).

One familiar species, the foamy cicadella, uses the froth it creates as a sunshade. With its proboscis sunk deep into a plant stem or leaf, it sucks out the sap, which it passes through a tiny mechanism at the tip of its abdomen. In this process it mixes air and a foam-forming substance with the sap, producing tiny bubbles having a tenacity that causes them to last for many hours.

The species reproduced are: Philippine Frog-hopper (*Gynopygoplax theora* White. Plate VII, figure 8), inhabiting the Philippines; Brazilian Frog-hopper (*Tomaspis furcata* Germ. Plate VII, figure 10), occurring in Brazil.

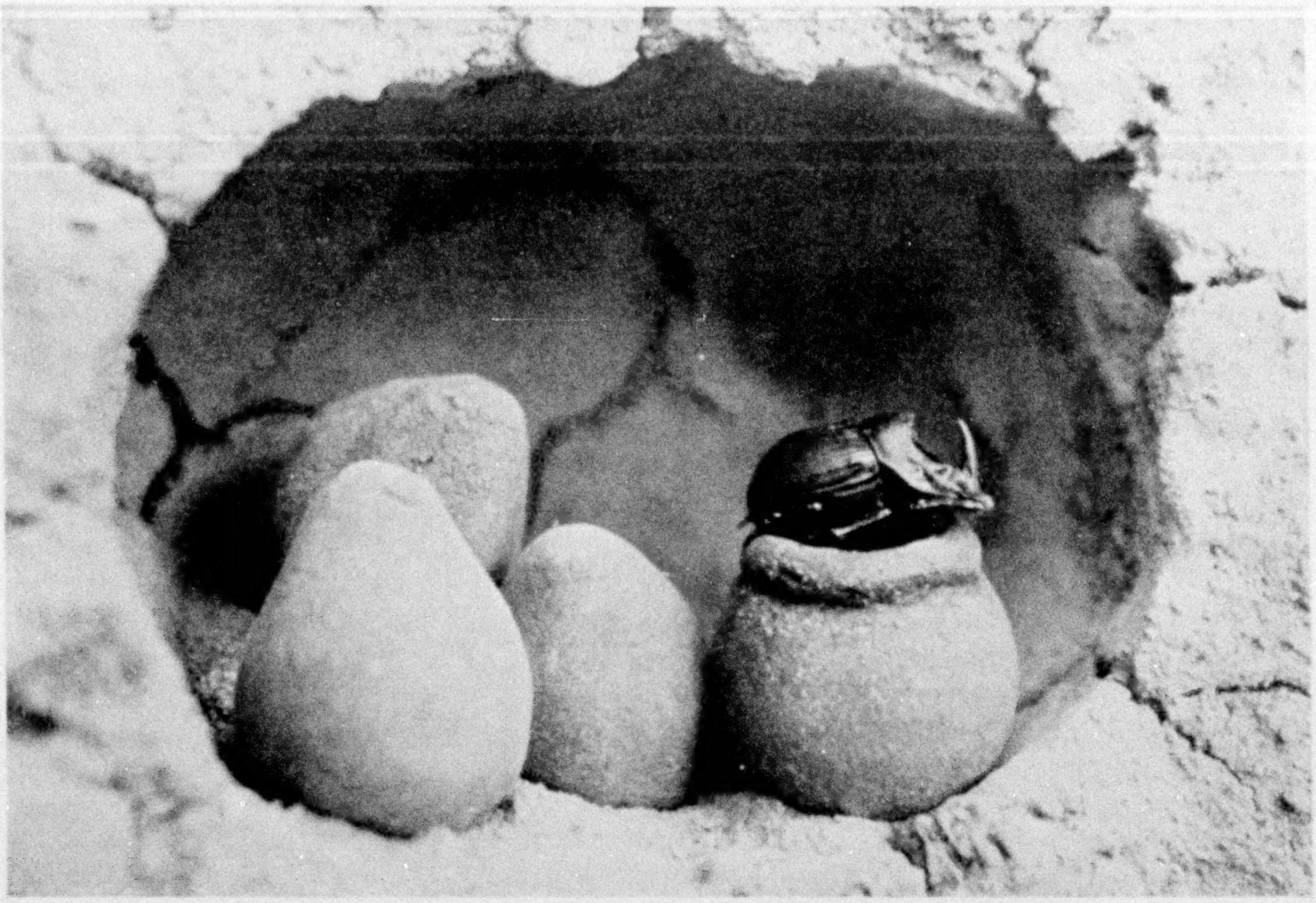
DRAGON- AND DAMSEL-FLIES

(Order *Odonata*)

Plate VIII

The creatures of this order might be called the hawks of insectdom. There are about 2,000 known species, 300 of which are found in the United States. Though bucolic superstition has it that the dragon-flies are snake doctors, that they sew up the ears of boys who wade in creeks, and that they are horse stingers and mule killers, they are, as a matter of fact, honest-to-goodness friends of everybody, since their favorite food is the pestiferous mosquito and the bothersome fly.

Compound eyes with as many as 30,000 facets are possessed by many species. These produce marvelous mosaics of images and give the possessor a wide angle of vision. Many species also have simple eyes to reënforce the powers of their compound optics. The dragon-fly's head is mounted on its body with an insectean version of a ball and socket joint, which enables the insect to see beneath and above itself—a power denied all except a few of the



Photograph by Paul Henri Fabre

A SCARAB OF SPAIN

It is one of the anomalies of Nature that, with few exceptions, the two groups of insects which show maternal solicitude for their young are the bees and the dung beetles. So intense is the affection of the latter for their children that the mother remains for four consecutive months without food, down in her burrow, looking after her brood, attending to their needs as grub, nymph, and finally as insect.

other members of the segmented, six-legged order of creatures.

In order to hold its prey, once overtaken, the dragon-fly groups its six legs together to form a basket in which the victim is clutched and held until the two front legs can get a firm grip on it. In some species the victim is eaten on the wing, in others the captor alights and eats at leisure. Most species breathe 118 times a minute as compared with the average man's 18 times. Ten pairs of breathing tubes lead from as many spiracles into the body.

The young of the damsel- and dragon-flies are wholly unlike their parents; they are aquatic. Down on the bed of a murky stream or muddy pond they dwell, thick of body, big of head, and half concealed in slime. Through their dirty, gray-green bodies they possess low visibility as they lie in ambush, waiting for some hapless creature to come their way.

When a May-fly larva, or a caddis-worm, or a water bug passes by on its unsuspecting way, the biggest mouth one ever saw on so small a creature opens wide and the luckless forager finds itself being chewed to pieces. The large lower lip effectually conceals the big mouth and sharp jaws until the prey comes by. Then the lip is extended and there shoots from the head a vicious pincerlike organ that grasps the victim and draws it in.

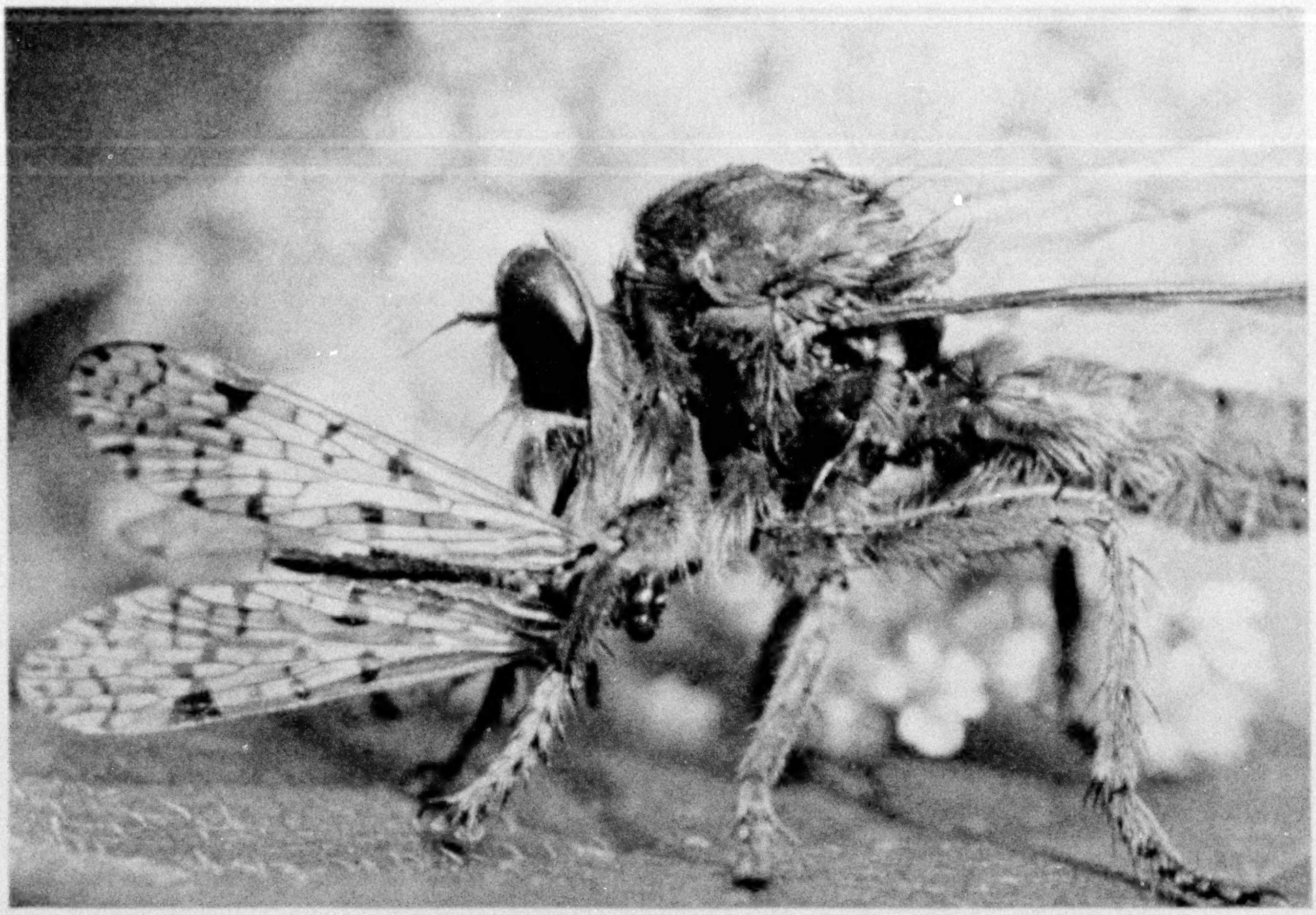
The nymphs propel themselves by drawing in and expelling drafts of water through their intestinal tracts. This expulsion is with considerable force, which, on the principle of the recoil of a gun, drives them forward a short distance.

Skimmer Family (*Libellulidae*). The dragon-flies of this family are found all over the country. The Water-prince is an unusually fine flyer and a hard creature to capture. The female flies alone when depositing her eggs, and makes her dips to the surface of the water some distance apart, so that her eggs may not be, so to speak, "all in one basket."

The species reproduced are: Ten Spot Skimmer (*Libellula pulchella* Drury. Plate VIII, figure 9), occurring in North America; Water-prince (*Epicordulia princeps* Hagen. Plate VIII, figure 11), also occurring in North America.

True Damsel-fly Family (*Agrionidae*). This family includes about 75 species in our fauna. The females deposit their eggs in the tissue of aquatic plants by cutting slits in the stems with their sharp ovipositors, or in the rubbish and mud along the border of ditches and the fringes of streams.

The males of some species are famous for the duels they fight. Flying about one another,



Photograph by Paul Griswold Howes

A ROBBER FLY WITH ITS PREY, A SCORPION-FLY

It is estimated that about 50 per cent of all the species of insects are engaged in preying on other species of their own kind. The robber flies are all swift, hairy, ferocious-looking creatures, without exception predatory. Some of them are very large, as much as two inches long. These latter do not hesitate to attack dragon-flies and bumble-bees and even the fierce and active tiger-beetles.

evidently in a consuming rage, each tries to get into a position to tear the other's wings, and the duel usually ends only when one of the contestants has been vanquished.

The Ruby-spot has been called by Kellogg a perfect masterpiece of insect beauty and grace. Only the males possess the colorful gems in their wings that give the species its name. Sometimes hundreds of them cling to willow branches in graceful festoons, where they look like strings of rubies.

The species reproduced are: Philippine Damsel-fly (*Pseudophaea refulgens* Selys. Plate VIII, figure 1), occurring in the Philippine Islands; Black-wing Damsel-fly (*Agrion maculatum* Beauv. Plate VIII, figure 2), inhabiting the eastern part of the United States; *Vestalis melania* Selys. (Plate VIII, figure 3), inhabiting the Philippines; Ruby-spot (*Hetaerina americana* Fab. Plate VIII, figure 7), habitat North America; *Neurobasis chinensis* Linn. (Plate VIII, figure 10), occurring in the Philippines.

BEES, WASPS, ANTS, AND THEIR KIN

(Order *Hymenoptera*)

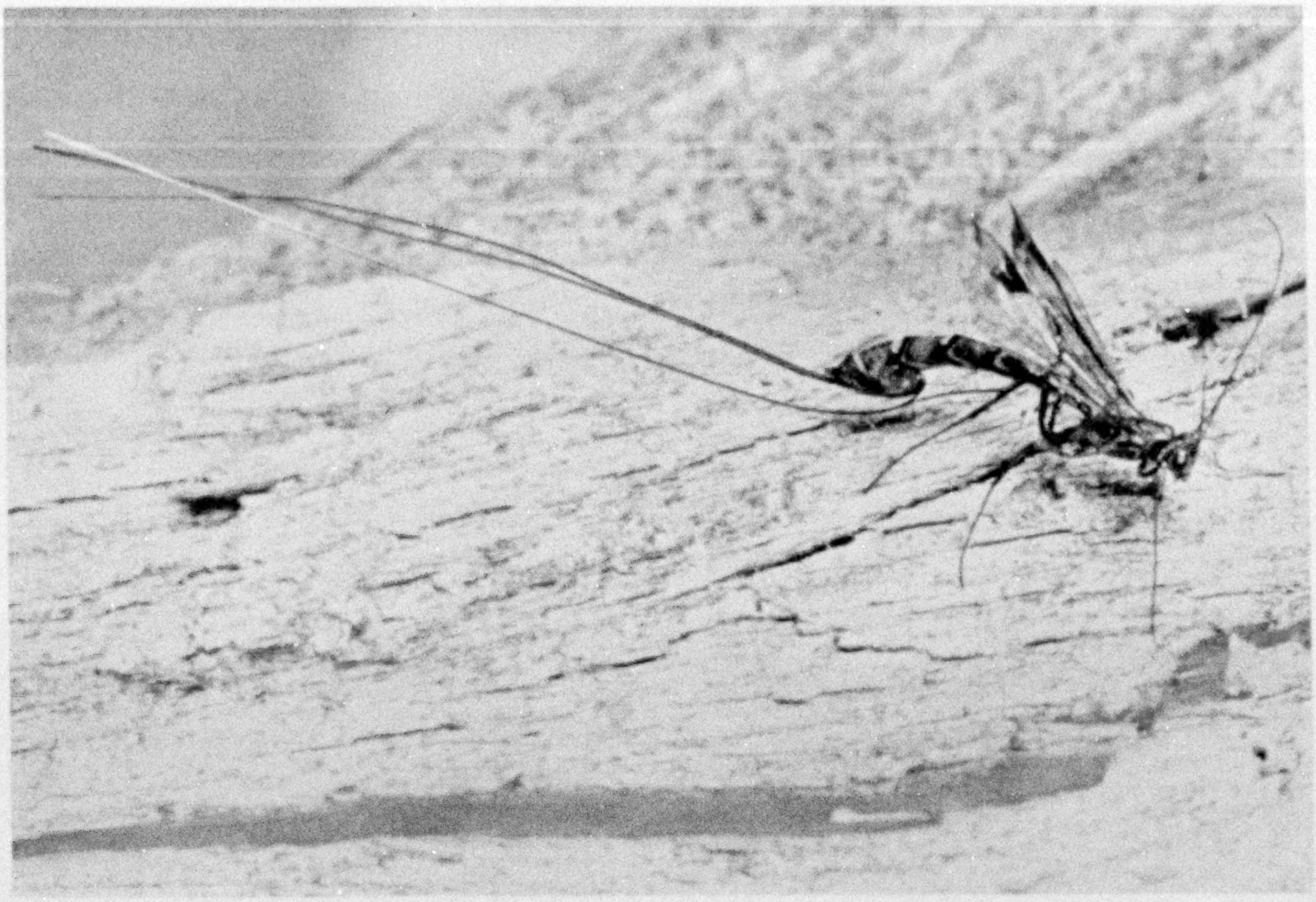
Plates X, XI, XII, XIII

More than 30,000 known species are grouped in this order, and there are perhaps ten times as many that never have been described, embracing not only the bees, wasps, and ants, but also the saw-flies, horn-tails, ensign flies, chalcid flies, gall flies, ichneumon flies, cuckoo flies, and many other lesser suborders, superfamilies, and families.

Thread-waisted Wasp Family (*Sphecidae*). Many species of solitary and hunting wasps, ranging in size and character of prey from the giant Cicada-killer to the little crabros whose quarry consists of harmless flies, are included in this family. They bag their game with rare finesse and preserve it with consummate art.

The familiar mud-daubers that build their several tubular cells side by side beneath porch roofs, on ceilings, and under the eaves of houses are characteristic members of the family. Although they work in mud, the mud-daubers are exquisite in their habits. If we watch one of them gathering a pellet of mud we will see her feet get dirty and the ends of her mandibles soiled; but, figuratively, she has her skirts carefully tucked up and her sleeves as carefully rolled out of harm's way. And when her work is over every particle of dirt must be scraped off both mandibles and feet.

When the dog days are with us, and lyremen, harvest-flies, and dog day cicadas begin their



Photograph by Lynwood M. Chace

AN INSECTEAN DRILL—(THALESSA) MEGARHYSSA LUNATOR

This ichneumon fly preys on the larvæ of the pigeon tremex, one of the horn-tails. The lowest of the three threadlike appendages is a flexible ovipositor. When the female finds the gallery of a pigeon tremex larva she elevates the ovipositor in a loop over her back and brings the tip down to the surface of the wood. She then makes a derrick out of her body and proceeds with great skill and precision to drill a hole into the burrow of the tremex. There she deposits an egg, from which soon emerges a larva to attack the larva of the tremex (see, also, text, page 52).

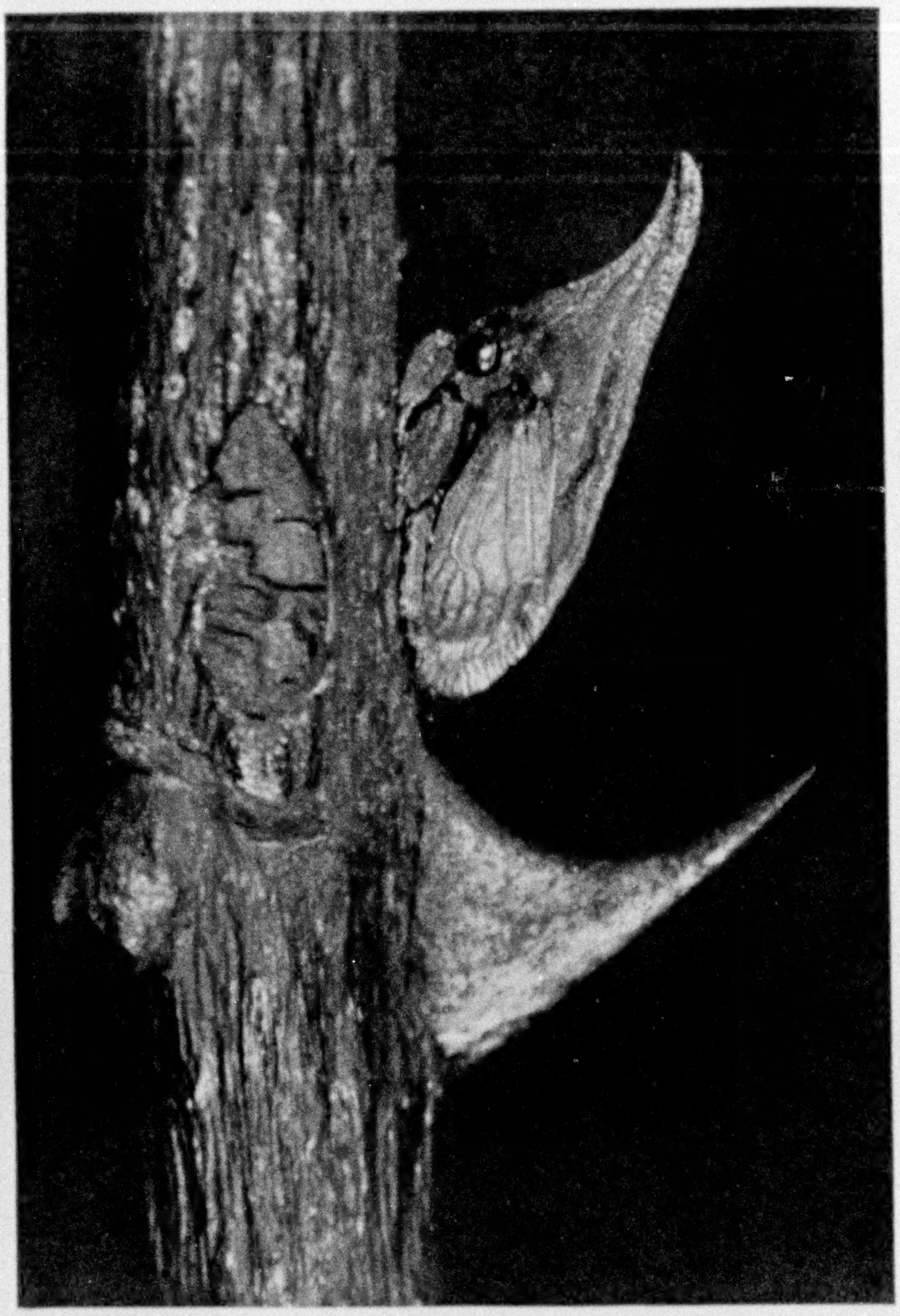
yearly din, their big, yellow-banded, rusty-black wasp enemy makes her appearance upon the scene, having come up out of the big burrow in clayey soil where her mother cradled her. Watch carefully and you will see the big huntress flying around in the vicinity of the source of the cicada's song. Suddenly that song ceases, and in its stead there comes a shrill, distressing, discordant note. The big wasp has driven her venomed dagger into the songster's nerve center, and with a shriek of pain the latter tumbles, along with its conqueror, to the ground.

Then comes the huntress's task of carrying her prey to her burrow. It is heavier than she is, so she gets astride it and laboriously drags it up a tree. From that vantage point she volplanes toward her burrow, after the fashion of a flying squirrel, and repeats the process until her home is reached.

Once there, she lays an egg under the middle leg of the victim, seals the cicada in a cell, and starts looking for another quarry. The egg hatches in two or three days, and the grub is assured of juicy meat, for the cicada has been paralyzed and not killed, and keeps fresh as long as the wasp's baby needs fresh meat. The grub attains full growth inside of ten days, and then spends two days spinning a cocoon of mixed silk and earth. In that it spends the winter, emerging from its transformation sleep in time to lend ear to the lyreman's call of a new season.

Another interesting species of this family is the sand wasp, known as the Ammophila. Dr. S. W. Williston, in studying them, discovered that these wasps actually have learned to use tools, but the discovery was so astounding to him that he feared to publish his observations at first, lest all mankind should pronounce him a "Nature faker." But many another entomologist has confirmed his discovery. After a mother Ammophila has finished digging her gallery, she captures a lot of small caterpillars or other insects, according to her species, paralyzes them, stocks the cell with them, and, after laying an egg in proximity to the provender, seals up the nest; then she fills the burrow with dirt. She often has been observed using a small pebble as a "tamping iron" to pack the soil in solidly, so as to remove effectually all trace of the gallery.

The Cerceris wasps, of which there are numerous American species, also belong to this family. They are exploiters of beetles and weevils. Some species specialize on the adults



Photograph by L. G. Saunders

A "BROWNIE" THAT MIMICS A THORN

One needs only to glance at the thorn itself and the tree-hopper above it to see how difficult it would be for an enemy of this insect to distinguish it from the thorn, whose protection it seeks through imitation (see, also, illustration, page 43).

of the flat-headed wood-borers. But though these vary widely alike in size, color, and aspect, the wasps that hunt them are able to recognize all of them with as much accuracy as the entomologist. Defour found 400 beetles that represented all the hues of the tar pot and the lapidary's show case combined, and were of all shapes and sizes, in Cerceris wasp cells. The wasps that gathered them never once went out of the wood-borer clan for their prey. Those Cerceris wasps that hunt weevils are just as good classificationists as the hunters of flat-headed wood-borers. Little weevils, big weevils, highly colored weevils, and those that are garbed in drab hues are all recognized by their wasp exploiters.

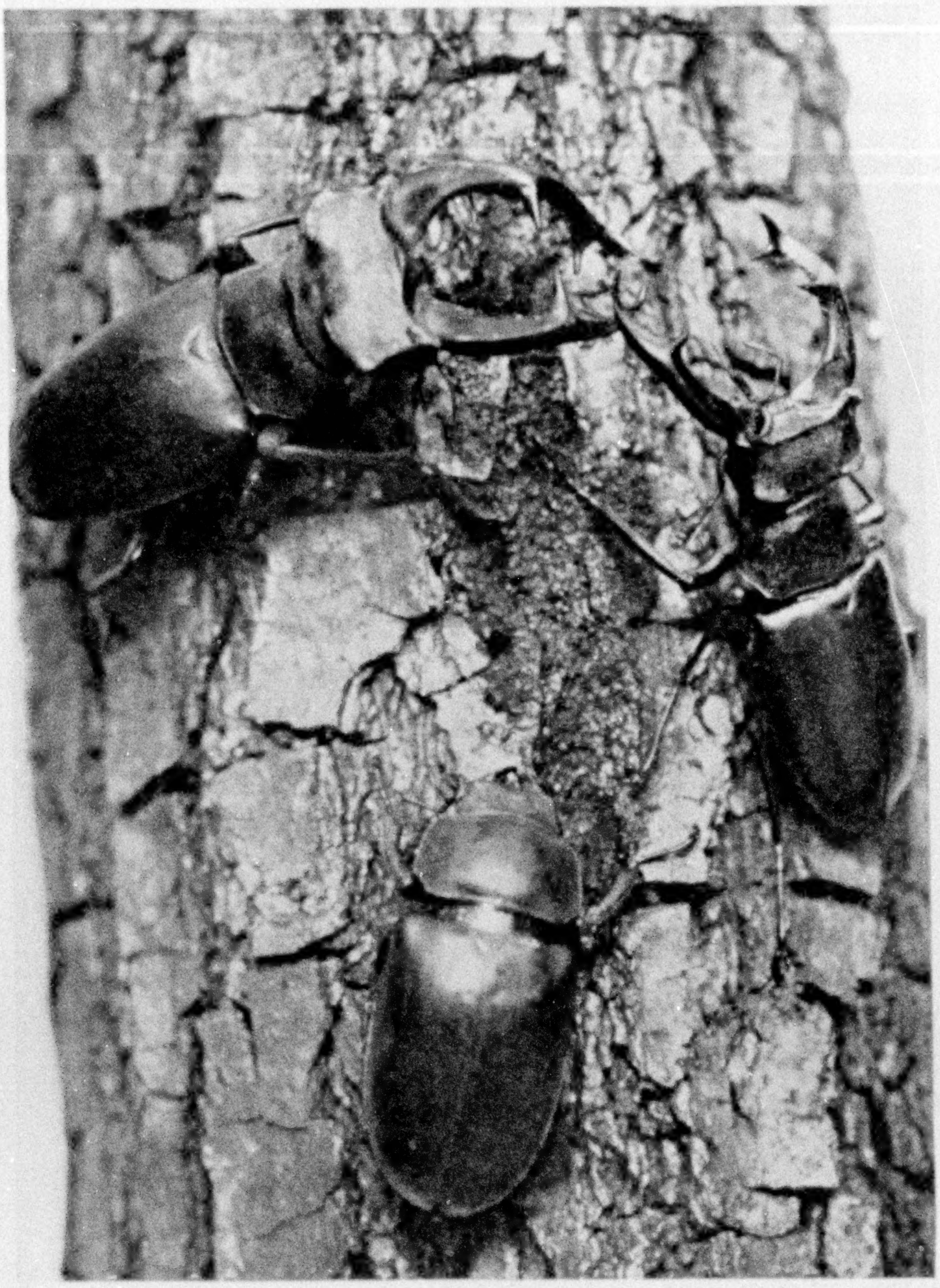
Anatomists who are masters of their art are the members of this family. Whether they be species that hunt wood-borers or species that prey upon weevils, each captive has its nerves centered in one ganglion. One thrust from the wasp's poisoned dagger produces complete paralysis, but not death, for death would mean mortification in a few days, and the babies of Cerceris must have fresh meat.

For weeks the beetle lives on, under the most powerful of sense-extinguishers. The wasp's egg, laid at the tenderest spot of the beetle's abdomen, hatches out, and the little grub begins to eat its way into the interior of the victim's carcass. But though the beetle's meat is as fresh as the day it was stung, there is no movement and no sense of pain.

Such a skilled surgeon was the mother of the grub that with her lance and her drug she was able to arrest sense and motion, and yet leave life. It is as if a man were to thrust a dagger into a steer's neck, insert with a hypodermic syringe a bit of poison into the wound, and establish a paralysis that would enable his child to carve the victim piecemeal over a period of four or five weeks, the beef meanwhile retaining its original freshness.

Another of the thread-waisted wasp family is Philanthus, a hunter of bees, not for her own rations but for her babies. For in her adult life she is a honey drinker and nectar sipper, while her babies are meat eaters. To present them with bees whose honey sacs were filled would be like giving a child a bouquet with a viper hidden in the flowers. Yet Mrs. Philanthus scarcely would be able to single out bees with empty crops. She therefore is under the necessity of emptying the bees' honey sacs before presenting them to her grubs. To do this she cannot deal with paralyzed bees.

Only death itself will produce that muscular relaxation necessary to force the last drop out of the bee's crop. Therefore, we find in her a new kind of surgeon. She has discovered that by forcing down the head of the bee, a tiny opening in its armor is found—an opening less than one twenty-fifth of an inch in diameter. With unerring aim Mrs. Philanthus causes her sting to penetrate the vital spot. A little poison is injected into the wound, and almost instantly antennæ and mandibles be-



Photograph by Paul Henri Fabre

STAG-BEETLES READY TO DO BATTLE OVER A FEMALE OF THE SPECIES

The adult beetles are found on trees, where presumably they live, for the most part, on the sap flowing from bruised places, and on honeydew of aphids and scale insects. Their eggs are laid in crevices of the bark near the base of the trunk. The fat-bodied grubs burrow into the tree, where they stay, in some species, for as long as six years.

come still. Death supervenes in a minute or so, and then the wasp begins a kneading process that forces out the last drop of honey from the bee's crop. This she drinks with gusto, and then carries the honey-drained victim to her home and gives it to her baby.

The species reproduced are: Sphex Wasp (*Chlorion cyaneum* Dahlb. Plate X, figure 1), inhabiting North America; Siamese Wasp (*Chlorion lobatum* Fab. Plate X, figure 3), native of Siam; Cicada-killer Wasp (*Sphecius speciosus* Drury. Plate X, figure 10), inhabiting the United States; Solitary Wasp (*Stictia signata* Linn. Plate XI, figure 2), occurring in Central America; American Mud-dauber (*Sceliphron caementarium* Drury. Plate XI, figure 7), living in North America; American Hunting Wasp (*Ammobia ichneumonea* Linn. Plate XI, figure 9), occurring in North and Central America.

Velvet Ant Family (*Mutillidae*). These handsome insects are not ants at all, but rather wingless wasps, which so closely resemble ants as frequently to be confused with them. Only the females are wingless, the males being possessors of the art of flight. Most of the members of this family are guests or parasites in the nests of other wasps and bees. They are strong stingers and swift runners, and number about 200 species in the United States.

The species reproduced is: Velvet Ant (*Dasymutilla occidentalis* Linn. Plate X, figures 2 and 6), found in North America.

Spider Wasp Family (*Psammocharidae*). Most species of this family are digger wasps, although a few are masons. The giant tarantula killer, the largest of all our wasps, belongs to this clan, and its sensational combats with the great hairy tarantula often are seen in the Southwest. Occasionally both lose, the tarantula paralyzed by the wasp's sting and the wasp dying from the poisonous wounds made by the great fangs of the spider. Those wasps of the family which burrow in the ground first find their victims and sting them until they are paralyzed. Then they dig a burrow, which is enlarged at the lower end, forming a cell for the reception of the spider; and the quarry then is dragged down into the cell and an egg attached to it, after which the passage to the cell is filled with earth.

The species reproduced is: Spider Wasp (*Pepsis cinnabarina* Lucas. Plate X, figure 4), which occurs in the southern part of North America and Central America.

Carpenter-bee Family (*Xylocopidae*). The carpenter-bees build their nests in wood. Perhaps the most familiar member of this family

Photograph by Lynwood M. Chace

A CRICKET'S GOLDEN CASTLE—A PUMPKIN BLOSSOM

"April comes to an end, and the cricket's song begins, at first in rare and shy solos, soon developing into a general symphony, in which every clod of turf boasts its performer." (See, also, text, page 37).

is the big, black carpenter-bee, as large as a bumble-bee, which excavates a burrow one-half inch in diameter in dry lumber. This burrow runs across the grain for about half an inch, and then makes a right-angle turn and runs with the grain for from 12 to 20 inches.

The bee works from two to three days on the small section of the tunnel that runs across the grain, and from three to five weeks on the remainder. If man did as much in proportion to his size, he could dig a tunnel two feet in diameter from end to end of a log 90 feet long, with no tool but his teeth.

The species reproduced are: Sumatran Carpenter-bee (*Xylocopa caerulea* Fab. Plate X, figure 5), inhabiting Sumatra; American Carpenter-bee (*Xylocopa virginica* Linn. Plate XI, figure 1), occurring in North America; Carpenter-bee (*Xylocopa bombylans* Fab. Plate XII, figure 8), living in Australia.

Euglossid Bee Family (*Euglossidae*). The several species of this family of bees are solitary in habits. Many of them have not been studied carefully, but those which are known build their nests from bits of boxwood which they fasten together with the resin or gum of trees.

The species reproduced are: Tropical Bee (*Eulaema dimidiata* Linn. Plate X, figure 7), a native of Central America; South American Bee (*Exaerte frontalis* Guer. Plate X, figure 8), found in Central and South America; *Euglossa variabilis* Friese. Plate XII, figure 10), found in Central America.

Social Wasp Family (*Vespidae*). This family includes the hornets, the yellow-jackets, and the wasps that build paper nests. Unlike the social bees and ants, the members of the social wasp family found in temperate regions

Photograph by Lynwood M. Chace

A CRICKET CONFERENCE ON AN EAR OF CORN

While the crickets we know best are the black and brown varieties found in houses and fields, there are many others we see less frequently. Some of these live in trees like katydids, others burrow into the ground like moles, and still others dwell as guests in ants' nests. Most of them hear with their legs and sing with their wings (see text, page 14).

are unable to set up a permanent communal life.

There is a vast lot of work to be done in the making of a hornet's nest as big as a half bushel. In the spring it is smaller than a hen's egg; it has been built by some queen that has survived the winter. The house must be made roomier as the family grows, not by building additions here and there, but rather by a gradual and symmetrical expansion of the entire structure. Think how often each bit of weatherboarding must be moved to keep the size of the house always expanding uniformly with the increase in the size of the family!

But the hornets are equal to the task, though that task is as if we took a six-room house and expanded it into a Windsor Castle without interfering in the slightest with the family routine on the inside, or with the shapeliness of the structure on the outside.

The hornets have the requisite engineering skill to carry the undertaking through to a successful conclusion. They gather from the weathered surfaces of boards, rails, and posts the pulp out of which they build the walls of the nest. Bit by bit they take the material from the inside of the nest walls and plaster it on the outside, supplementing it with new material gathered abroad. In this way the inside of the house always is being put on the outside, and the growth of the nest provided for.

Many species of yellow-jackets build their nests in hollow logs and stumps. What most laymen know as the common wasp belongs to the genus *Polistes* of the *Vespidae* family. It builds but a single comb, always in a place protected from the elements, so that there is no need for the outer covering provided by the hornets. Like their cousins, the yellow-jackets and the hornets, they bring food to their babies as it is needed rather than store it up in the cell before the egg is deposited. There are some exceptions to the general rule that the *Vespidae* are social wasps. A few unfamiliar species are solitary in their habits.

The species reproduced are: Asian Wasp (*Vespa mandarina* Smith. Plate X, figure 9), found in Asia; European Social Wasp (*Vespa crabro* Linn. Plate XI, figure 10), a native of Europe and Asia and introduced into North America; Yellow-jacket (*Vespula carolina* Linn. Plate XII, figure 6), found in North America.

Bumble-bee Family (*Bombidae*). The bumble-bee family is represented by numerous species in our fauna, most of whose communities are short-lived rather than permanent. The only individuals that live over winter are the fertilized females. They find some cranny or crevice where the frost cannot reach them, and there fall into a winter-long sleep.

When spring arrives they seek a deserted mouse hole, mole burrow, or other cavity in the ground. To these nests they bring pollen and honey which they knead into bread. Then they lay eggs in simple cells, and the larvæ that hatch from them grow fat and strong on the bread prepared in advance by the mothers. When the grubs are grown they spin silken cocoons in which they pupate, and out of which they emerge full-fledged bumble-bees. Then they immediately set to work looking after the welfare of their newly hatched younger sisters and brothers, serving as nursemaids, housemaids, food gatherers and what not, and freeing their elder sisters for field work.

When winter approaches the colony dies, leaving behind only a few fertilized females, whose duty it will be to start the work again the next year. There are some species of bumble-bees that are parasitic on their more industrious cousins. They closely resemble the working clans and possess no worker caste.

The species reproduced is: Common Bumble-bee (*Bombus americanorum* Fab. Plate XI, figure 3), found in North America.

Ichneumon Fly Family (*Ichneumonidae*). The ichneumon fly family possesses some 6,000 known species. Most of them are parasitic and exploit the caterpillar tribe, thus helping to keep in check some of the worst enemies of the American garden, orchard, truck patch, and field. The adults, as a rule, lay their eggs on the caterpillars, and the larvæ hatch out and burrow into the wretched host, literally eating it alive. Anyone who gathers cocoons to see what kinds of insects issue therefrom will have ichneumon flies coming from them almost as frequently as the rightful owners.

An interesting ichneumon is known as (*Pimpla*) *Ichneumon conquisitor*. It preys on the tent-caterpillar. When the latter's cocoon is spun, the ichneumon, with its ovipositor, makes an opening in the silken case and deposits its egg. The parasite has at once a choice cradle and a meal for its needs—at the expense of the sleeping, transforming caterpillar.

Another species, (*Pimpla*) *Ichneumon inquisitor*, preys not only on tent-caterpillars but also on army-worms, tussock moths, caterpillars, and the like.

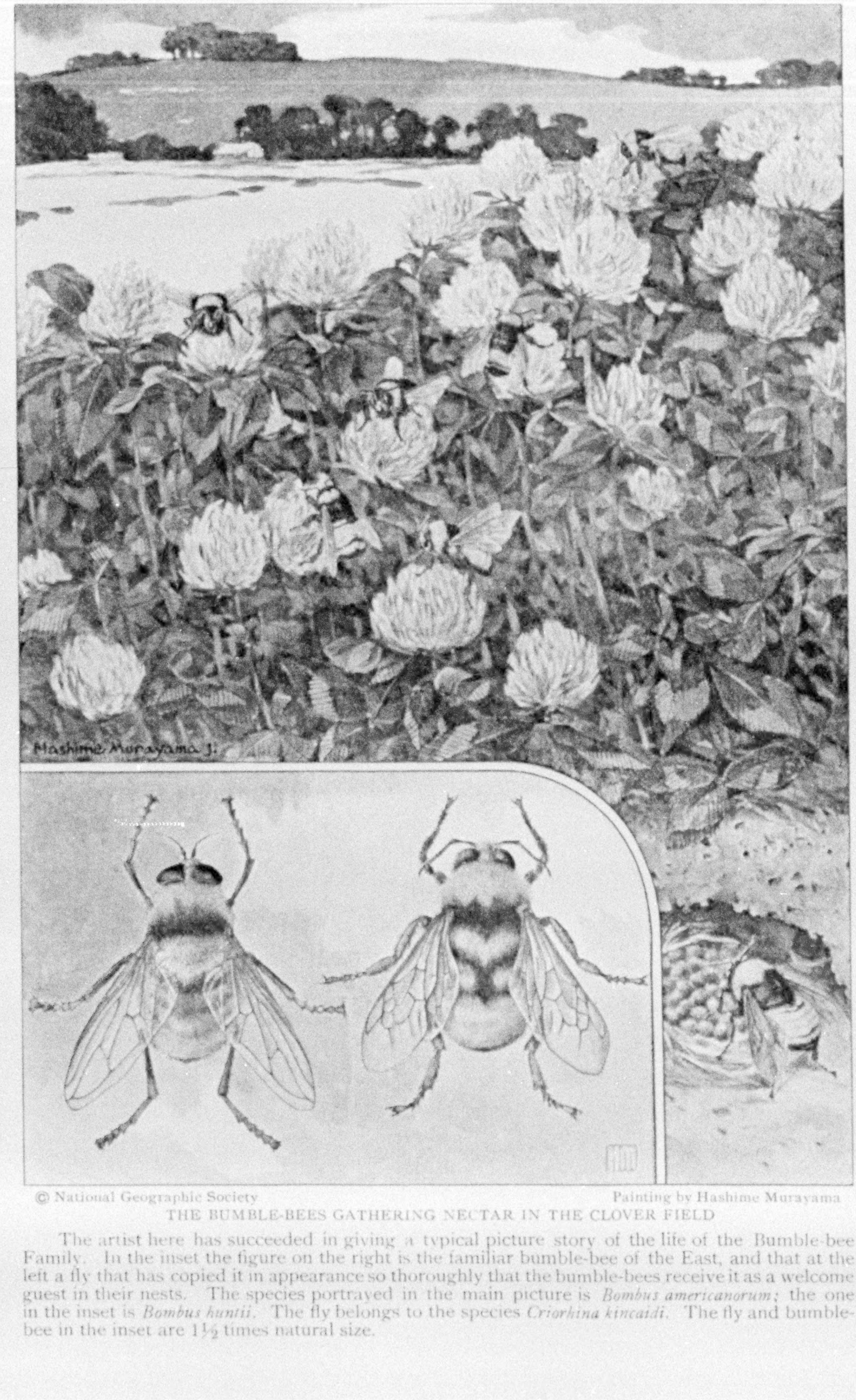
The most interesting of all the ichneumon flies is probably (*Thalessa*) *Megarhyssa lunator*. The female of this species has an amazing ovipositor, often as long as six inches, which is made up of several hairs and a flexible tube. The hairs form a sheath for the latter, which is the boring-tool proper. Thin and flexible as it seems to be, Mrs. Thalessa, once she has located, deep in the hard wood of a tree, the boring grub of a pigeon tremex, bends her long abdomen down, throws her ovipositor up over her back and brings the end of it down to the wood. She then begins as fine a drilling operation as one would wish to see, often driving the hole down three or four inches into the wood (see illustration, page 47). After the female completes the boring, she converts her drill into an egg-tube, and through it pumps an egg down into the burrow of the pigeon tremex's baby (see, also, Horn-tail Family, page 61).

This egg promptly hatches, and soon attaches itself to the luckless tremex grub which it gradually devours, and then lies down for a transformation nap.

Sometimes when Mrs. Thalessa starts to drill, the wood is so tough that it grips her drill and she remains a prisoner until starvation ends her career.

The species reproduced are: American Ichneumon Fly (*Amblyteles grandis* Brulle. Plate XI, figure 4), American Ichneumon Fly (*Trogus elegans* Cress. Plate XI, figure 5), American Ichneumon Fly (*Trogus rileyi* Cress. Plate XI, figure 6), *Agathilla bradleyi* Vireck (Plate XIII, figure 1), *Amblyteles jucundus* Brulle. (Plate XIII, figure 4), *Platylabus clarus* Cress. (Plate XIII, figure 5), *Amblyteles jucundus* Brulle. (Plate XIII, figure 6), *Polyaenus spinarius* Brulle. (Plate XIII, figure 8), *Amblyteles w-album* Cress. (Plate XIII, figure 9), *Ichneumon irritator* Fab. (Plate XIII, figure 10), *Amblyteles semicaeruleus* Cress. (Plate XIII, figure 11), *Labena grallator* Say. (Plate XIII, figure 12), all found in North America; *Macrojoppa blandita* Cress. (Plate XIII, figure 2), habitat Central America; *Cyanoxorides caeruleus* Cameron. (Plate XIII, figure 3), found in the Philippine Islands; *Callicryptus fasciipennis* Brulle. (Plate XIII, figure 7), a species found in Cuba; *Lissopimpla semipunctata* Kirby. (Plate XIII, figure 13), native of Australia.

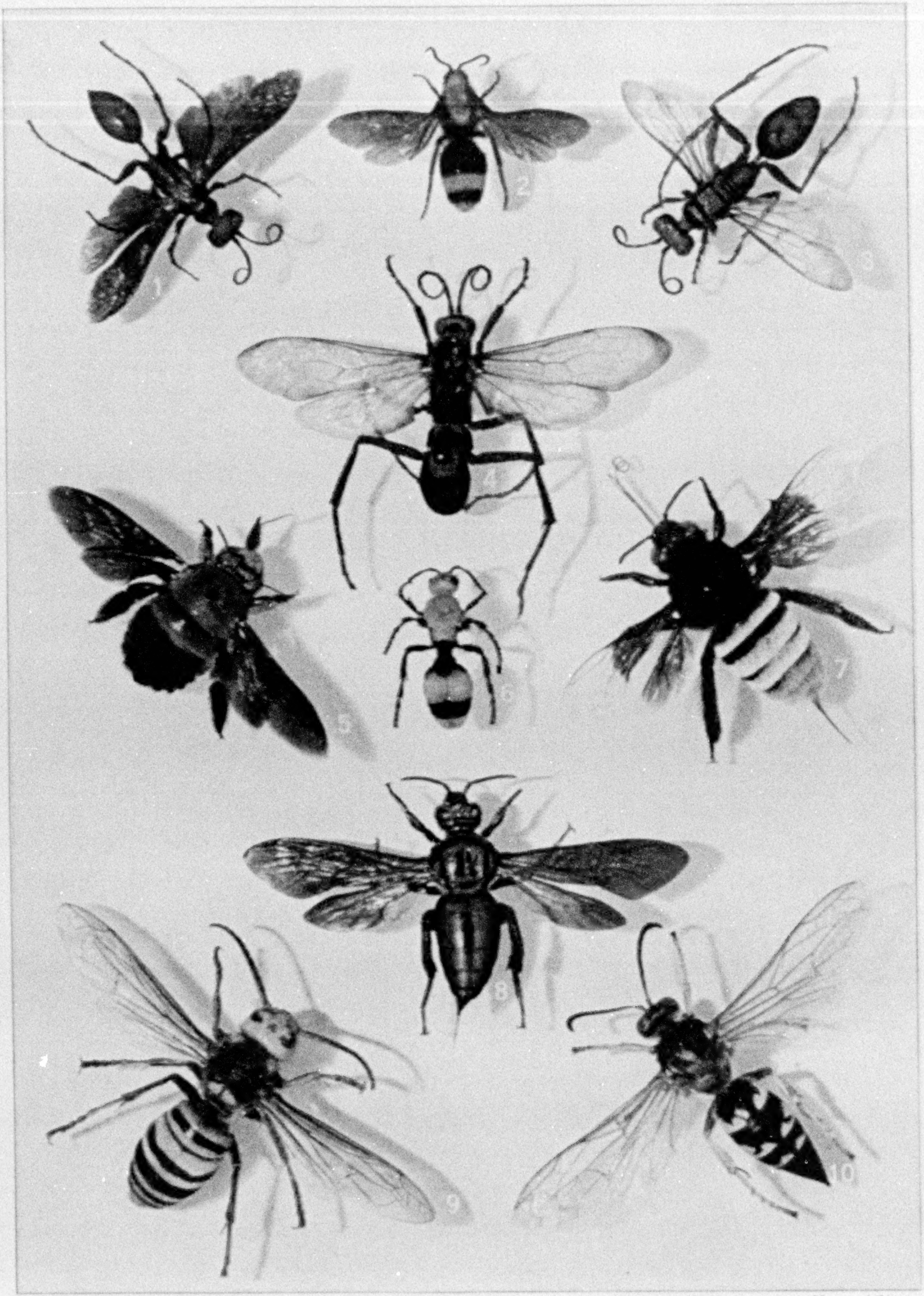
Scoliid Wasp Family (*Scoliidae*). The species of this family neither builds nests nor transports prey to them. Rather it digs into the ground, where the grubs of the family to which the May beetle belongs are to be found. Discovering one of these, the wasp stings and


Hashime Murayama J.

© National Geographic Society Painting by Hashime Murayama

THE BUMBLE-BEES GATHERING NECTAR IN THE CLOVER FIELD

The artist here has succeeded in giving a typical picture story of the life of the Bumble-bee Family. In the inset the figure on the right is the familiar bumble-bee of the East, and that at the left a fly that has copied it in appearance so thoroughly that the bumble-bees receive it as a welcome guest in their nests. The species portrayed in the main picture is *Bombus americanorum;* the one in the inset is *Bombus huntii.* The fly belongs to the species *Criorhina kincaidi.* The fly and bumble-bee in the inset are 1½ times natural size.



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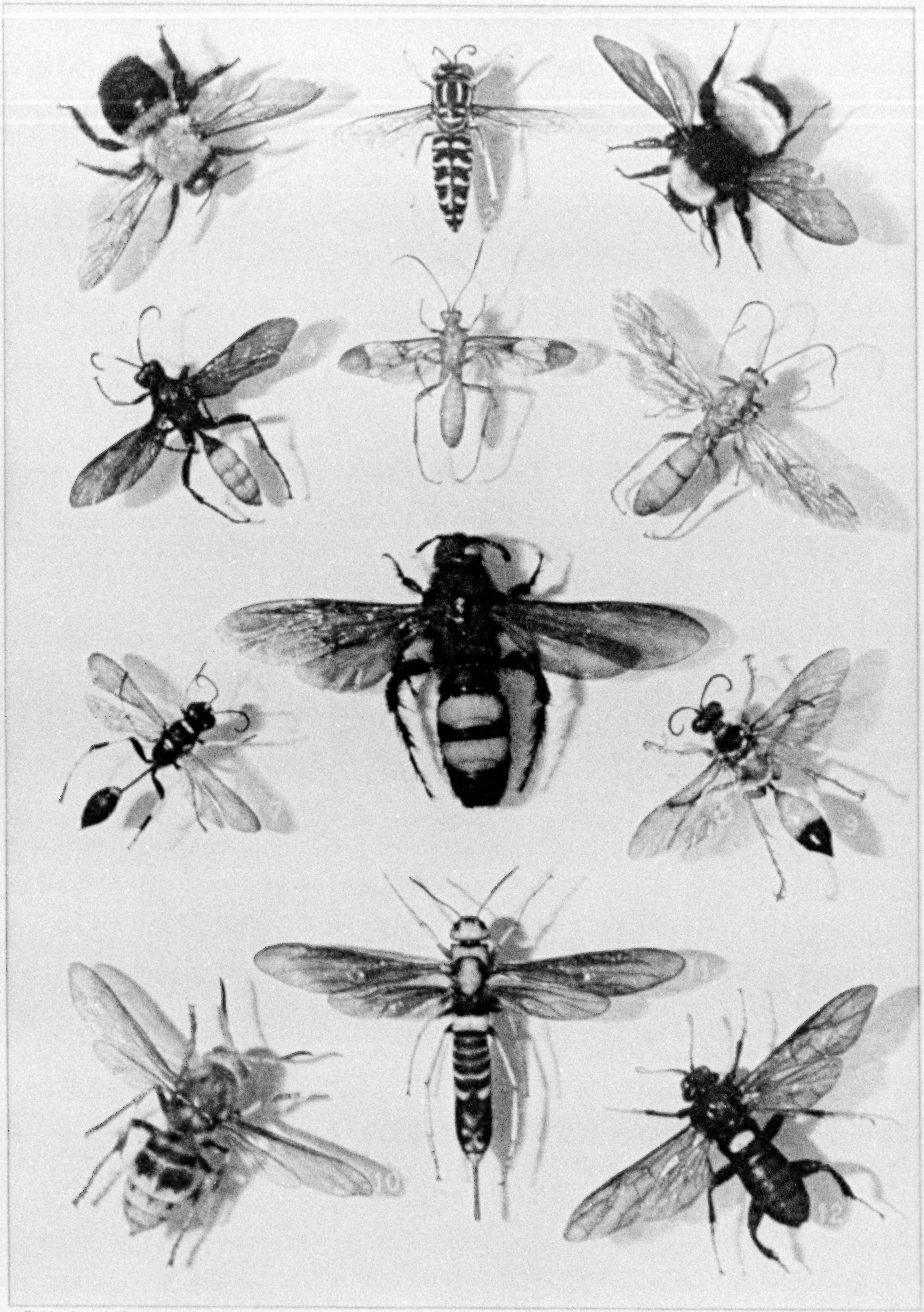
Natural Size

SOME OF THE FAIREST AMONG THE WASPS, BEES, AND VELVET ANTS

(1) Sphex Wasp, *Chlorion cyaneum* Dahlb. [Female]; (2) Velvet Ant, *Dasymutilla occidentalis* Linn. [Male]; (3) Siamese Wasp, *Chlorion lobatum* Fab. [Female]; (4) Spider Wasp, *Pepsis cinnabarina* Lucas [Female]; (5) Sumatran Carpenter-bee, *Xylocopa caerulea* Fab. [Female]; (6) Velvet Ant, *Dasymutilla occidentalis* Linn. [Female]; (7) Tropical Bee, *Eulaema dimidiata* Linn. [Female]; (8) South American Bee, *Exaerte frontalis* Guer. [Female]; (9) Asian Wasp, *Vespa mandarina* Smith [Female, queen]; (10) Cicada-killer Wasp, *Sphecius speciosus* Drury [Female]. See text under the following Family headings: Thread-waisted Wasp, Velvet Ant, Spider Wasp, Carpenter-bee, Euglossid Bee, and Social Wasp. The habits of the several species of these insects show to what a high degree of versatility members of a single Order may attain, whether in social relationships, home-building habits or food-gathering and storing methods.



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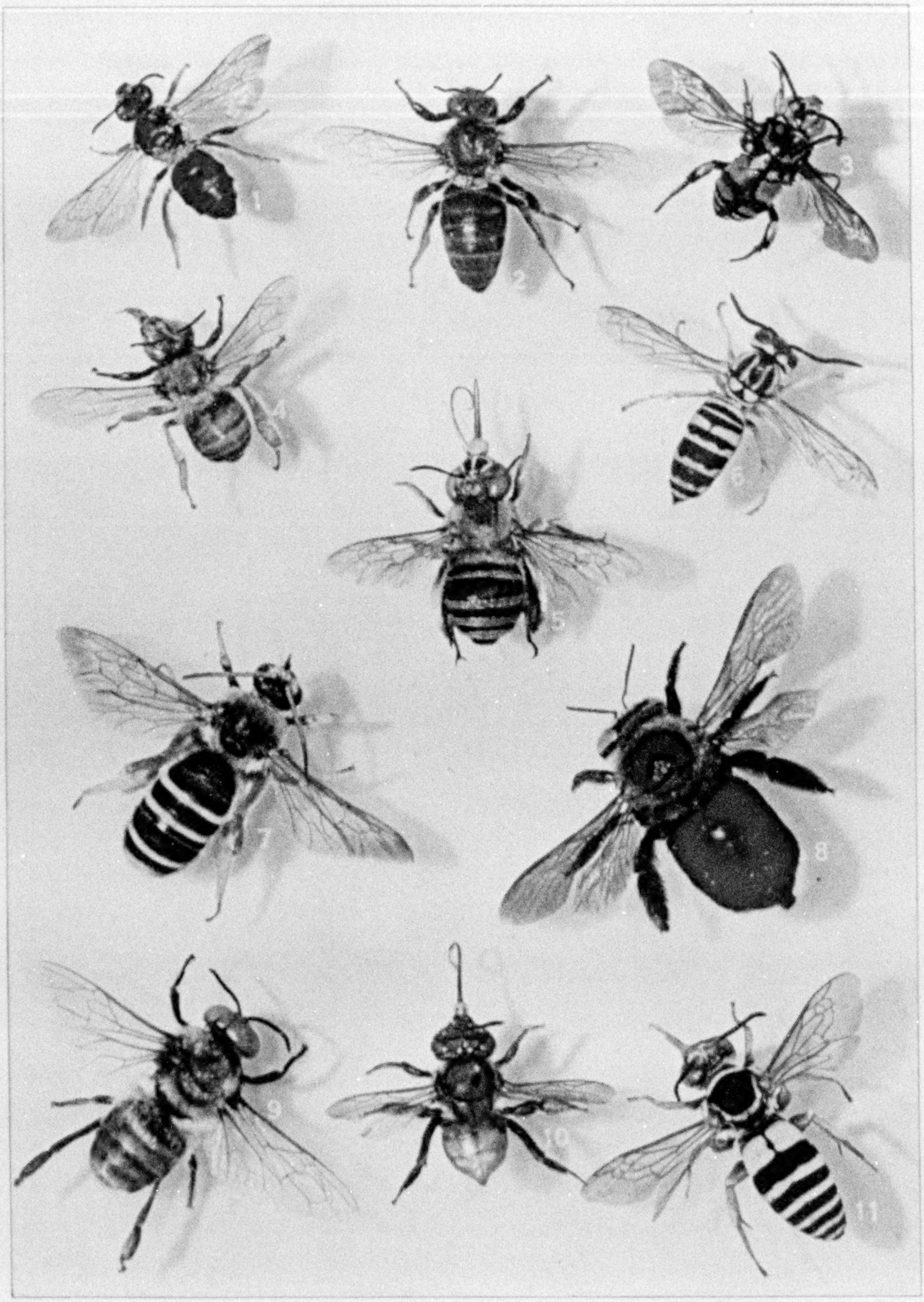
1¼ times Natural Size

FROM CARPENTER-BEES TO SAW-FLIES RANGES THE COLLECTION ON THIS PLATE

(1) American Carpenter-bee, *Xylocopa virginica* Linn. [Male]; (2) Solitary Wasp, *Stictia signata* Linn. [Female]; (3) Common Bumble-bee, *Bombus americanorum* Fab. [Female, queen]; (4) American Ichneumon Fly, *Amblyteles grandis* Brulle [Female]; (5) American Ichneumon Fly, *Trogus elegans* Cress. [Female]; (6) American Ichneumon Fly, *Trogus rileyi* Cress. [Female]; (7) American Mud-dauber, *Sceliphron caementarium* Drury [Female]; (8) South American Burrowing Wasp, *Campsomeris ephippium* Say [Female]; (9) American Hunting Wasp, *Ammobia ichneumonea* Linn. [Female]; (10) European Social Wasp, *Vespa crabro* Linn. [Female]; (11) Common Horntail, *Tremex columba* Linn. [Female]; (12) American Saw-fly, *Cimbex americana* Leach [Male]. See text under the following Family headings: Carpenter-bee, Thread-waisted Wasp, Bumble-bee, Ichneumon Fly, Scoliid Wasp, Horn-tail, and Cimbicid.



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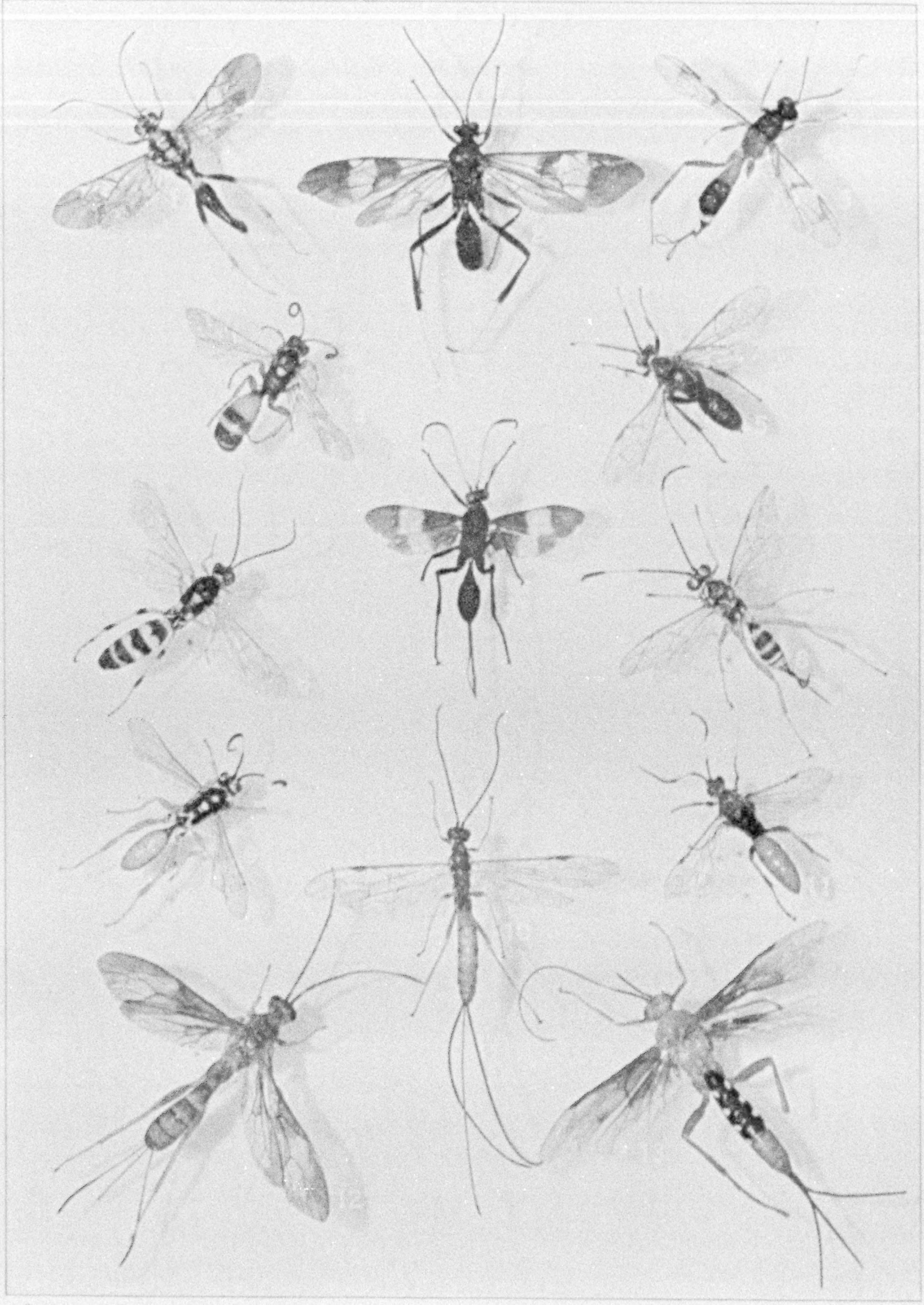
Twice Natural Size

A GROUP OF HYMENOPTERS OF STRANGELY CONTRASTING WAYS OF LIFE

(1) American Burrowing Bee, *Agapostemon splendens* Lep. [Female]; (2) Honey-bee, *Apis mellifera* Linn. [Female, queen]; (3) *Crocisa crucifera* Ckll. [Female]; (4) Honey-bee, *Apis mellifera* Linn. [Female, worker]; (5) *Anthophora zonata* Linn. [Female]; (6) Yellow-jacket, *Vespula carolina* Linn. [Female, worker]; (7) *Nomia nortoni* Cress. [Male]; (8) Carpenter-bee, *Xylocopa bombylans* Fab. [Female]; (9) Honey-bee, *Apis mellifera* Linn. [Male, drone]; (10) *Euglossa variabilis* Friese [Female]; (11) *Triepeolus quadrifasciatus* Say [Male]. See text under the following Family headings: Halictus Bee, Honey-bee, Melecta Bee, Anthophora Bee, Social Wasp, Carpenter-bee, and Euglossid Bee.



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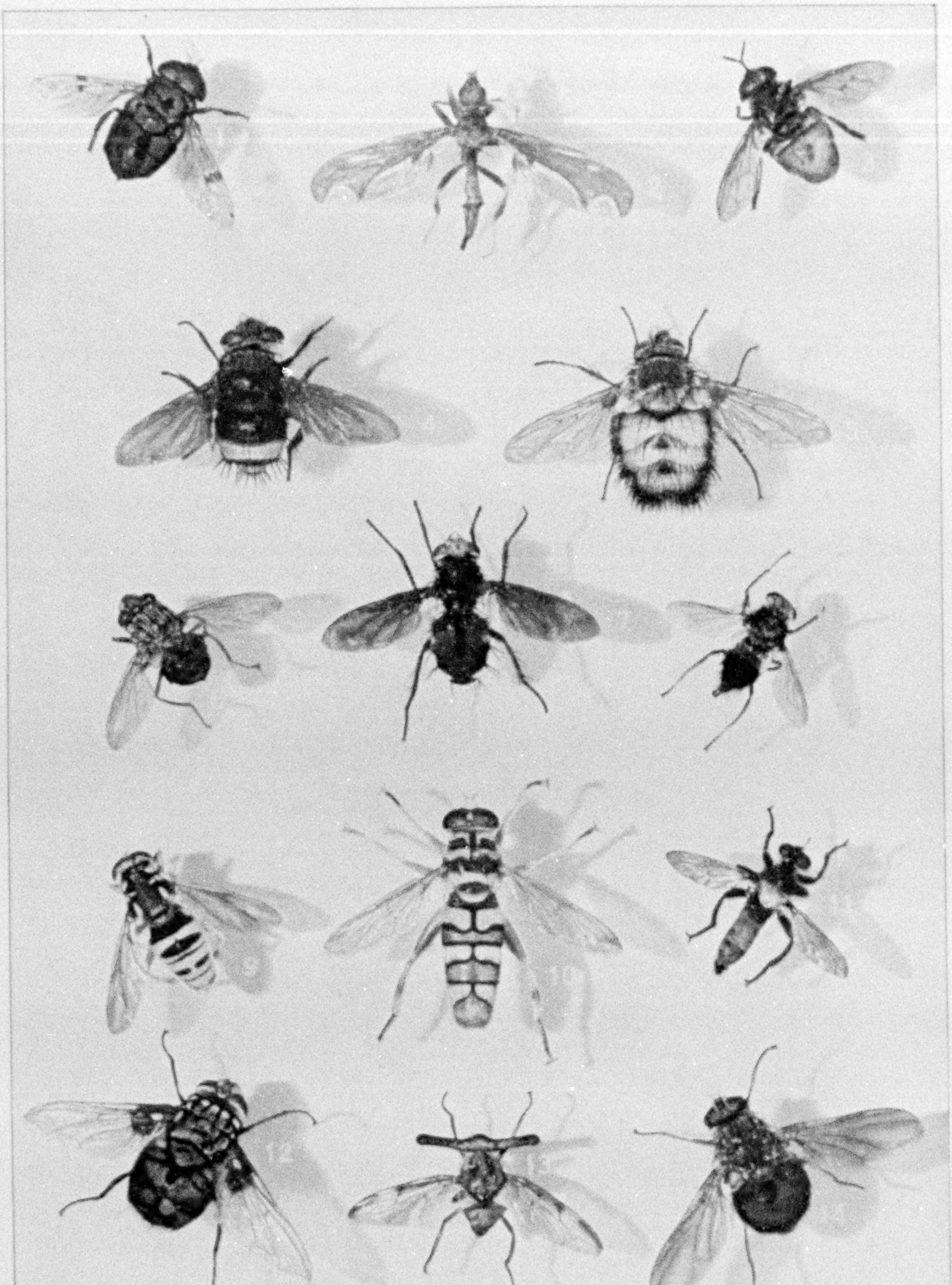
1½ times Natural Size

A BAKER'S DOZEN OF ICHNEUMON FLIES THAT ARE MAN'S CONSTANT ALLIES

(1) *Agathilla bradleyi* Vireck [Male]; (2) *Macrojoppa blandita* Cress. [Male]; (3) *Cyanoxorides caeruleus* Cameron [Female]; (4) *Amblyteles jucundus* Brulle [Female]; (5) *Platylabus clarus* Cress. [Female]; (6) *Amblyteles jucundus* Brulle [Male]; (7) *Callicryptus fasciipennis* Brulle [Female]; (8) *Polyaenus spinarius* Brulle [Female]; (9) *Amblyteles w-album* Cress. [Female]; (10) *Ichneumon irritator* Fab. [Female]; (11) *Amblyteles semicaeruleus* Cress. [Female]; (12) *Labena grallator* Say [Female]; (13) *Lissopimpla semipunctata* Kirby [Female]. All of the species represented on this Plate belong to the single Family of the Ichneumon Flies. Few among any of the Families of all the Orders of insects render man a greater service than the Ichneumon Flies.



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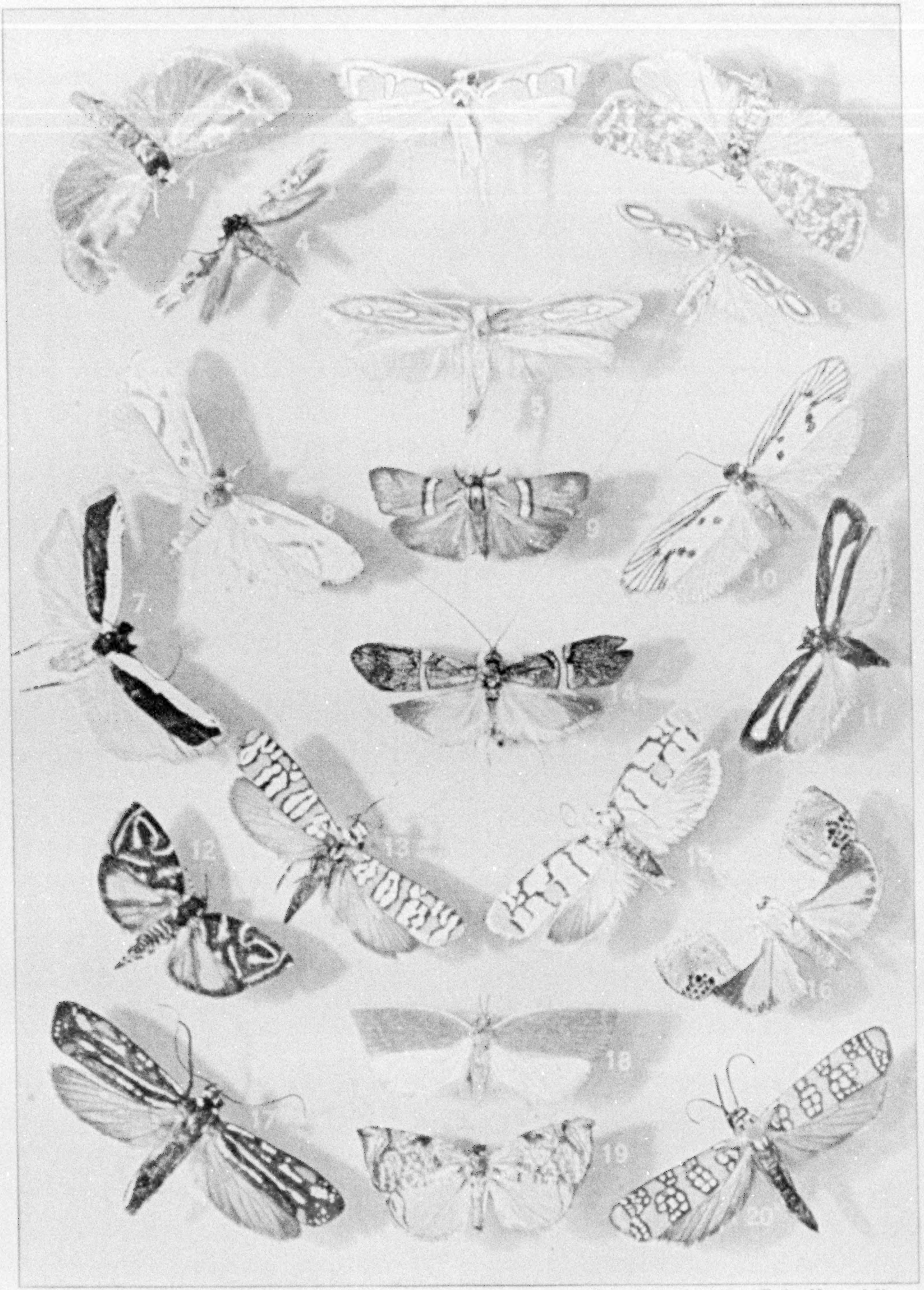
1½ times Natural Size

TWO-WINGED FLIES—FAMILIAR AND OTHERWISE

(1) Tropical Hover Fly, *Volucella obesa* Fab. [Female]; (2) May Beetle Fly, *Pyrgota undata* Wiedemann [Female]; (3) Florida Ant Fly, *Microdon fulgens* Wiedemann [Female]; (4) Eastern Tachina Fly, *Belvesia bifasciata* Fab. [Female]; (5) Western Tachina Fly, *Paradejeania rutiliodes* Jaennicke [Female]; (6) Central American Bot Fly, *Dermatobia hominis* Linn. [Female]; (7) Scavenger Fly, *Silbomyia fuscipennis* Fab. [Female]; (8) Ox Warble, *Hypoderma lineatum* DeVilliers [Female]; (9) Eastern Hover Fly, *Temnostoma excentricum* Harris [Male]; (10) *Milesia virginiensis* Drury [Male]; (11) California Robber Fly, *Laphria coquilletti* McAtee [Male]; (12) Australian Nimble Fly, *Rutilia splendida* Donovan [Female]; (13) *Achias amplividens* Walker [Female]; (14) Costa Rican Blow-fly, *Mesembrinella umbrosa* Aldrich [Female]. See text under the following Family headings: Hover Fly, Pyrgota Fly, Tachina Fly, Bot Fly, Blow-fly, Robber Fly, Nimble Fly, and Ortalid Fly.



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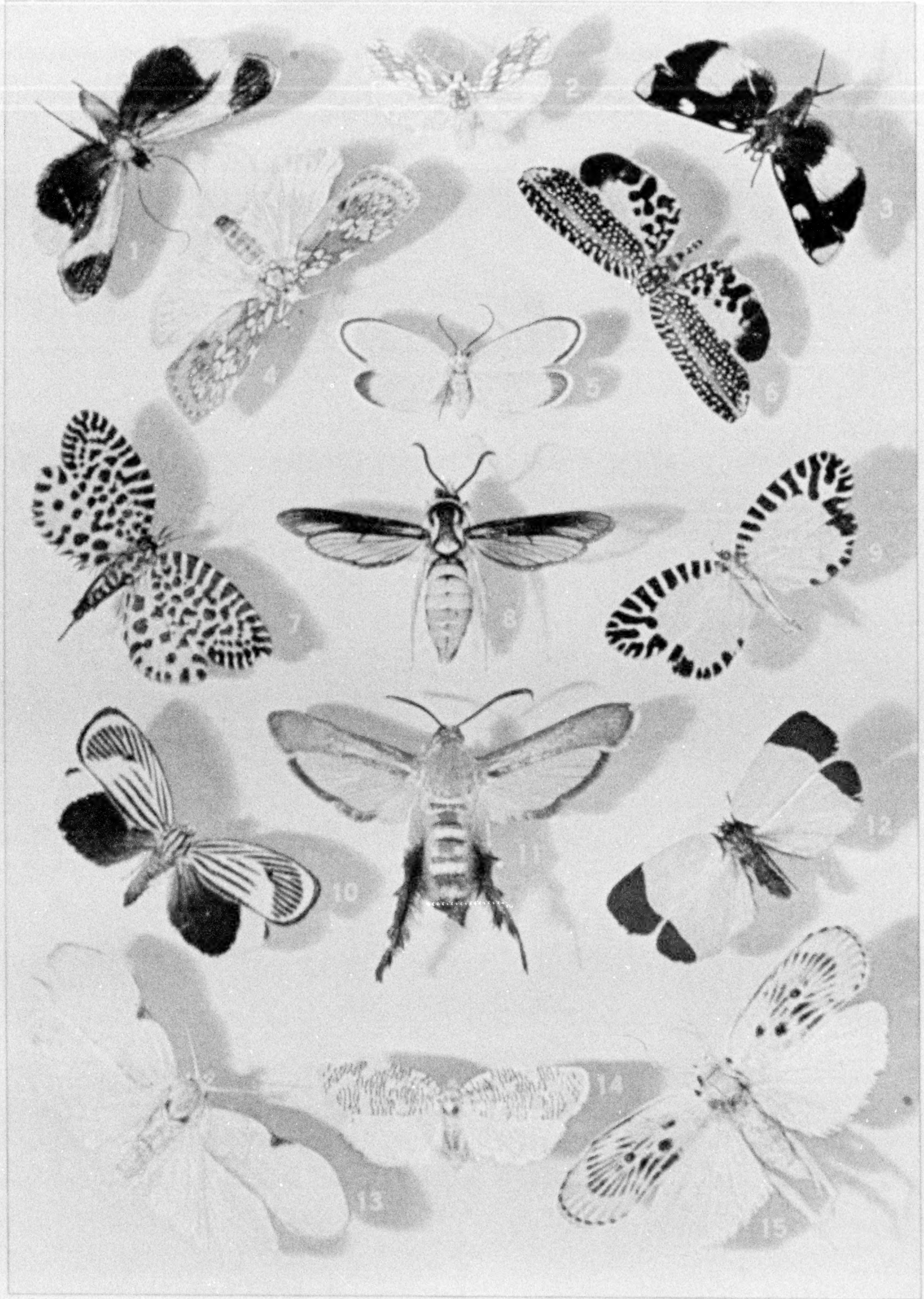
Twice Natural Size

LILIPUTS OF THE SCALY-WINGED WORLD—MICRO-LEPIDOPTERA

(1) European Pine Shoot Moth, *Rhyacionia buoliana* Schiffermüller [Female]; (2) *Lupercalia ignita* Busck [Male]; (3) Virginia Pine Moth, *Petrova virginiana* Busck [Female]; (4) *Psacaphora edithella* Barnes & Busck [Male]; (5) Palmetto Leaf-miner, *Homaledra heptathalama* Busck [Female]; (6) *Filinota hermosella* Busck [Male]; (7) *Atasthalistis tricolor* Felder [Female]; (8) *Mieza citrina* Busck [Male]; (9) *Tortyra cuprinella* Busck [Female]; (10) *Mieza laetae* Hubner [Female]; (11) *Mieza spatula* Busck [Male]; (12) *Hemerophila albertiana* Stoll [Male]; (13) *Atteva exquisita* Busck [Female]; (14) *Nematois chrysoprasias* Meyrick [Male]; (15) *Ethmia festiva* Busck [Female]; (16) *Grapholitha egregiana* Felder [Female]; (17) *Atteva hysginiella* Wallengreen [Female]; (18) *Phytomimia chlorophylla* Walsingham [Female]; (19) *Mictopsichia durranti* Walsingham [Male]; (20) *Atteva pustulella* Fab. [Male]. All of the Families represented on this Plate will be found in the text under the Order heading The Little Moths.

XUM



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1⅕ times Natural Size

A CHARMING GROUP OF MICRO-LEPIDOPTERA ARRAYED IN RESPLENDENT ROBES

(1) *Coryptilum klugii* Zeller [Male]; (2) *Lactura conflagrans* Walker [Male]; (3) *Atasthalistis concinnalis* Feisthamel [Male]; (4) *Hypercallia miniata* Dognin [Female]; (5) *Pseudotalara regia* Schaus [Female]; (6) *Cerace onustana* Walker [Male]; (7) *Pseudatteria leopardina* Butler [Female]; (8) *Paranthrene palmi* Harry Edwards [Female]; (9) *Pseudatteria mimica* Felder [Female]; (10) *Imma grammozona* Meyrick [Male]; (11) Western Clear Winged Moth, *Melittia gloriosa* Harry Edwards [Male]; (12) *Megalodoris electrina* Meyrick [Male]; (13) *Stenoma elegans* Zeller [Female]; (14) *Tortrix animosana* Busck [Female]; (15) *Stenoma armata* Zeller [Male]. The Micro-lepidoptera Families lack common names. The species represented on this Plate will be found in the text under the Order heading The Little Moths.

paralyzes it and then builds a crude cell around it, after attaching an egg to the grub. The larva of the wasp, hatching out, consumes the grub and then spins a cocoon in which it develops.

The species reproduced is: South American Burrowing Wasp (*Campsomeris ephippium* Say. Plate XI, figure 8), found in South and Central America.

Horn-tail Family (*Siricidae*). This family consists of about 100 species, about one-third found in America. Its members are mostly rather large, brightly marked, and well-built. The adult female has an ovipositor consisting of five pieces, the two outside ones forming a sheath, and two of the others being furnished at the tip with a series of fine, hard, transverse ridges arranged like the teeth of a file. With this she is able to match the work of a gimlet or auger in human hands, and can drill innumerable holes in the solid wood of a tree. In each of these she places an egg.

The best-known of the horn-tails is the pigeon tremex, which is about one and one-half inches long, with a rusty head and thorax, and a black abdomen with yellow bands and spots. The female bores a hole half an inch deep into elms, oaks, sycamores, and maple trees. The larvæ, hatching from the eggs laid therein, burrow into the heart wood where they grow into cylindrical, blunt-ended, whitish grubs, measuring about an inch and a half in length.

When ready to transform into an adult insect, the grub makes a cocoon of silk and chips, and then goes to sleep. On awakening as a full-fledged pigeon tremex it bores out at right angles to the gallery dug by the grub, instinctively knowing that in such direction lies the shortest way to liberty.

The European grain cephus, whose larvæ bore into the stems of wheat and cause the straw to break about harvest time, belongs to the horn-tail tribe. About the time the head of the wheat begins to form, the fly bores a small hole in the straw. When the larva hatches from the inserted egg, it tunnels down the stem, and by wheat-cutting time has passed below the level of the cutter bar. In this way it remains in the stubble, where it makes a silken cocoon and hibernates.

The species reproduced is: Common Horn-tail (*Tremex columba* Linn. Plate XI, figure 11), found all over North America.

Cimbicid Family (*Cimbicidae*). The most familiar species of the group is the American Saw-fly. Its eggs are laid in June in crescent-shaped slits made in leaves. The food plants are elm, birch, linden, and willow. When disturbed the larva spurts a fluid from glands just above the spiracles. When it is full-grown it burrows in the ground, makes an oval, brownish cocoon, and spends the winter there, not changing to a pupa until spring. It emerges in May or June.

The species reproduced is: American Saw-fly (*Cimbex americana* Leach. Plate XI, figure 12), habitat North America.

Halictus Bee Family (*Halictidae*). Some of these bees are larger than a fair-sized wasp and some are smaller than a house-fly. Every halictus carries what has been called a clearly written certificate of her guild. It is a smooth, shiny line, or groove, on the last segment of the abdomen that acts as a guide for the sting. Some species build wonderful cells for their babies.

The burrows in which these are located may be rough, but the cradles must be perfect. Leading from the burrow, the cells are excavated so as to resemble water bottles laid on the side. No human plasterer ever did a finer job than these bees. First there is a coating of clay, its surface roughened like the outside of a thimble. On this is laid a smooth coat, mixed with saliva and carefully troweled with the tongue—a glazing that is exquisite in its perfection, and both damp- and waterproof.

A small fly which the ordinary observer dismisses as nothing but a gnat, makes it her business to lay her eggs in the halictus's cells. Under the microscope she is revealed as a red-eyed, white-faced, gray-corselcted, black-legged marauder.

One species of this family studied by Fabre, the zebra halictus, possesses a quality rarely observed in the insect world—interest in grandchildren. The mother bee, of the spring generation, having passed the winter in some frost-proof retreat, gives the mansion she has built so laboriously to her daughters. Each daughter builds a small addition to the burrow and makes a group of cells of her own, but all use the main burrow in common.

The grandmother of the brood in the cells stands guard at the doorway, to keep out all but the rightful entrants—her daughters. Her velvet dress, so clean and handsome when she was a youthful matron, is now threadbare and dingy. Gone is the nap, all but lost are the beautiful stripes of red and brown.

But she has a grandmother's pride in the newly hatched grubs, and woe betide any creature who cannot show the yellow foot of the halictus folk when seeking to reach those grub chambers! A drubbing the marauder never will forget will be his certain portion. At the door, all day long, sits poor, bald-headed grandmother, a ghost of her former self, in a little sentry box at the mouth of the burrow, stepping aside to all those who can give the countersign, but wild as a witch in her anger toward any would-be intruder. Mayhap her remarkable guard over her grandchildren comes from the knowledge that some of them will be males. Denied the privilege of having sons, by that strange quirk of Nature which makes all the children of the spring generation females, she must look to her grandchildren for her male progeny. And each of those grandchildren is hatched into the world without a father.

With no males produced from the eggs of the spring mother, and no males having survived the winter, they perforce are born under that strange departure from the orthodox laws of reproduction known as parthenogenesis.

Photograph by Maynard Owen Williams

A CHINESE PEDDLER OF BIRD AND CRICKET CAGES

Singing crickets in cages are as familiar in the Orient as singing canaries in the Occident. Even the department stores in the larger cities of Japan cater to the cage-cricket trade. Hundreds of thousands of the insect Kreislers are sold every year.

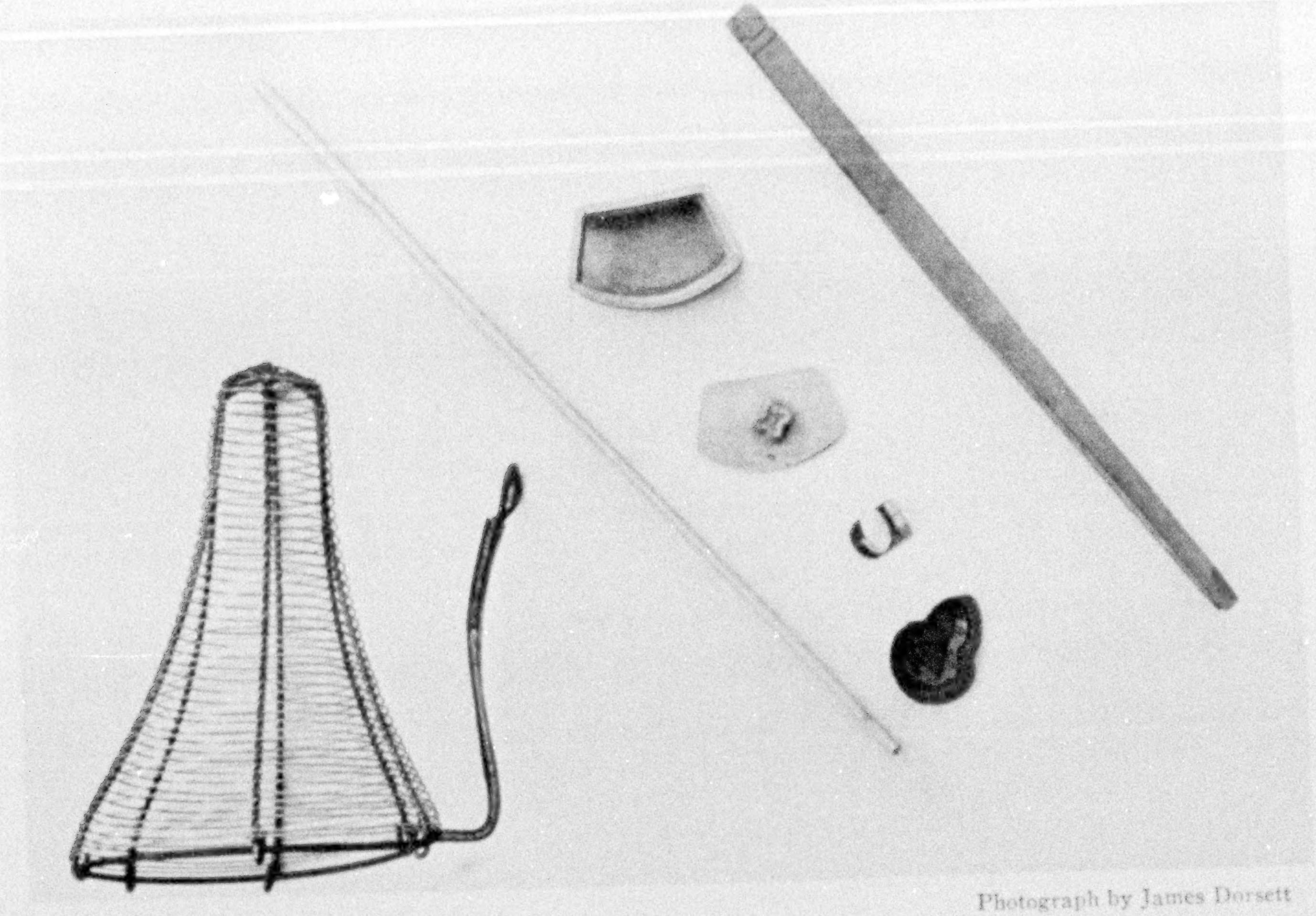
The species reproduced are: American Burrowing Bee (*Agapostemon splendens* Lep. Plate XII, figure 1), common in North America; *Nomia nortoni* Cress. (Plate XII, figure 7), occurring in North America.

Honey-bee Family (*Apidae*). The best known species of this family is the common hive-bee, *Apis mellifera*. A winter colony of honey-bees may consist of 10,000 members, and a summer colony of 50,000. Nowhere else in the world of Nature is maternal egotism so marvelously developed as in the queen bee.

In each hive one queen, and only the queen, has the right to motherhood—a law of the bee world as unalterable as the laws of the Medes and Persians. If another queen appears, even though she be the ruling sovereign's own daughter, there is civil war, and one or the other must leave. Fifty thousand of her children must renounce maternity and vow themselves to celibacy, although they could, if they willed, lay parthenogenetic eggs from which female bees would hatch. Indeed, in queenless hives, a worker does for the moment take up the task of egg-laying until a real queen is hatched.

There are brood cells and food cells to be built, food to be stored, wax to be secreted, filth to be removed, younglings to be nursed, invaders to be repelled, currents of air to be kept circulating, and queens to be supported. If we were to visit a hive at swarming time, we would, if we listened well, hear a great commotion within. A daughter grub has been fed with royal jelly and has blossomed forth a queen. She is ready to dispute with the mother the scepter of that hive. A battle royal takes place. Mother and daughter each have their adherents. If one is not the victim of the other's sting, the worsted one—and usually it is the mother that is worsted—sets up a shrill piping. This is a call to her adherents to join in shaking the dust of that bee city from their feet, and to go where base ingratitude does not reign, but where peace may rule again.

The wax from which honeycomb is fabricated is a secretion that exudes through tiny pores in a series of small plates on the under side of the bee's abdomen. In order to secrete one ounce of this wax the bees must eat 20 ounces of honey. They fill themselves to the gullet, then hang in festoons from the ceiling. By internal exertions they get warm enough to give the wax a liquid consistency as it oozes through the plates. Later it hardens, and then is removed, either by the manufacturer herself, or by another worker. After that it is kneaded and mixed with saliva with great care, and then put into the comb. In making brood comb, old wax may be used, but for honeycomb only new wax is employed. After the brood cells are made, the queen lays her eggs



Photograph by James Dorsett

EQUIPMENT USED IN HANDLING FIGHTING CRICKETS IN CHINA

In some parts of the Celestial Republic the sport of cricket fighting is as common as cockfighting in the countries of the Caribbean. At the left is the wire cage used for transferring the fighters to and from the ring. The light ferule next to the cage is the tickler, to stir up the fighters to a proper degree of anger. Beyond that are, respectively, from the bottom, the drinking trough, the food rack, the top of the cricket's house, and the house itself. At the right is a set of bamboo tweezers for handling food and equipment (see illustration, page 65).

in them. In three days these hatch into tiny larvæ, which are footless, helpless, soft-bodied grubs.

The nurses at once attend them, giving them as their first food a sort of pap or jelly formed in the nurses' stomachs and regurgitated for the grubs. After a few days, this diet is strengthened by the addition of a little honey and pollen to the menu. After a few days more, a bee bread made of honey and pollen is put into the cell, which then is sealed. After eating this, the grub falls into its transformation sleep, and slumbers for 13 days.

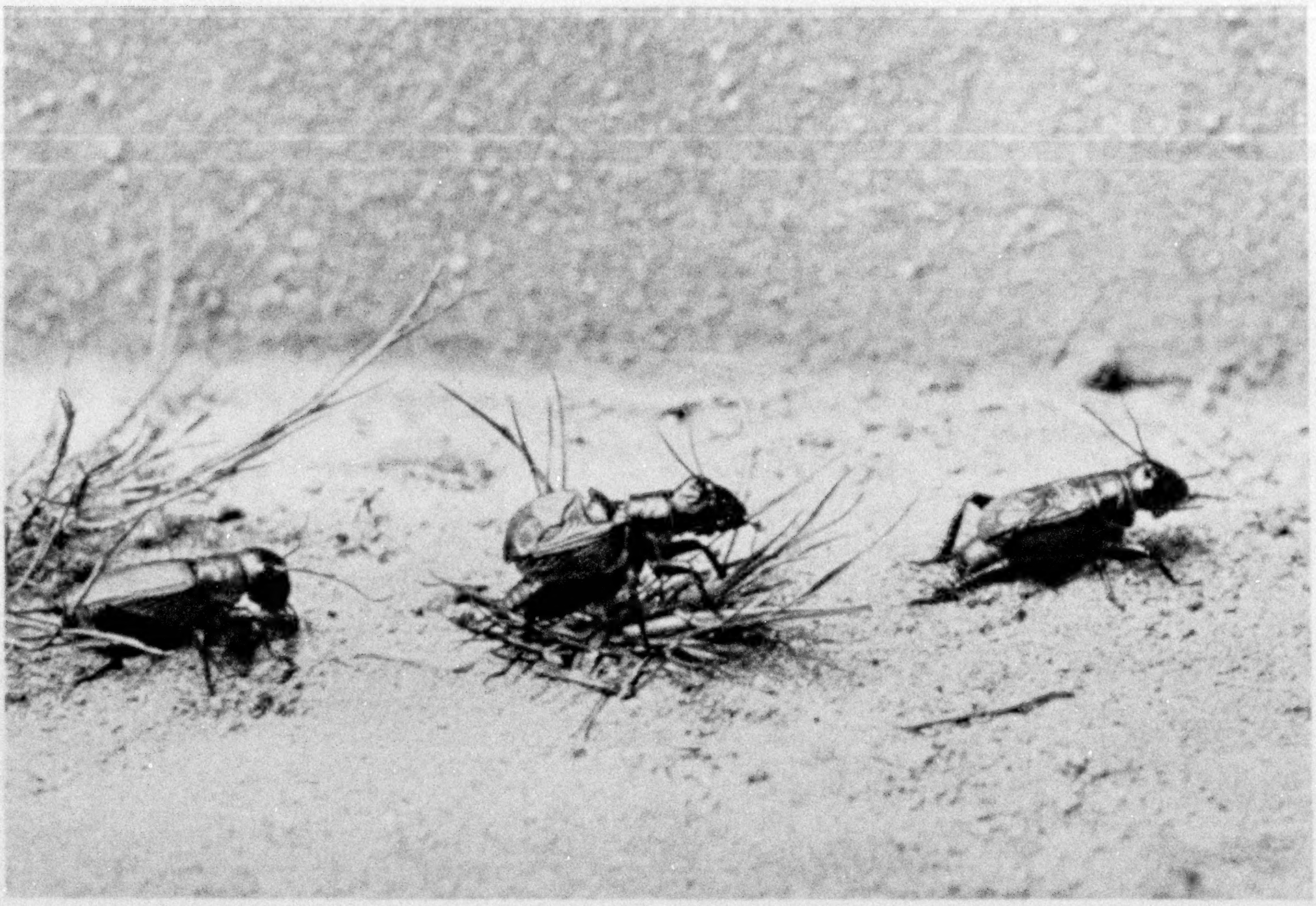
Then it awakens a full-fledged bee. But before it can go out into the open it must spend ten days or two weeks as an indoor worker, mayhap as a nurse, a scavenger, a ventilator, or each in turn. When the worker goes out she has the choice of drinking a given portion of nectar or of carrying it back to the hive. In front of her stomach is a honey sac. She fills this with nectar, carries it to the hive, regurgitates it into a honey cell or else into the mouth of an indoor worker.

Gradually the excess of water is evaporated, on the same principle that cane juice is boiled down into molasses. To render the honey antiseptic and to make it "keep," a tiny bit of formic acid is added to it by the bee. The pollen for the bee bread on which the indoor worker and the maturing larvæ feed is gathered from the flowers, tucked away in the pollen baskets on the bee's hind legs, and carried home.

It so happens that often, in hot weather, the natural condensation of the moisture of the hive is checked. At such times many workers transform themselves into winged water wagons, bringing water in their honey sacs to the thirsty ones in the hive. At other times material is needed to stop up the cracks and chinks in the hive—to keep out cold air—and they gather the resinous saps of various plants for mortar.

The ventilation of a hive is a fascinatingly interesting process. Workers arrange themselves on the floor and through the superstructure of the hive, and by a synchronized vibration of their wings set up air currents that expel the impure air and draw in the fresh, employing exactly the same principle that is used by mining engineers in keeping mines supplied with pure air.

One of the most pitiable spectacles in an apiary is to see a hive of bees thoroughly cowed by those of another hive, and standing by while the marauders carry out their honey. Ordinarily, there is a doughty guard at every



Photograph by Paul Henri Fabre

THE END OF A BATTLE BETWEEN SUITORS IN CRICKET LAND

The conquered suitor scampers away, while the conqueror insults him with a song of triumph. The lady cricket looks on very demurely from behind.

bee gate, and whoever would find stolen sweets within that gate may expect a drubbing such as pilferers deserve. But once in a while the occupants of a strong and lusty hive make a foray upon a weak one, and there is a bitter war in which the defenders are worsted. Once cowed by a mass attack, individual enemies seem able to maintain the terrorism, and to carry forward their pillaging at will.

The species reproduced is: Honey-bee (*Apis mellifera* Linn. Plate XII, figures 2, 4, and 9).

Melecta Bee Family (*Melectidae*). This family is made up of two groups, one of which is parasitic. The members of the parasitic tribe are true cuckoos. They have learned that well-known manner of living recorded in Holy Writ, "Reaping where thou hast not sown, and gathering where thou hast not strawed." Some of them single out some industrious species and take up quarters with them uninvited, eating the viands of their hosts as though they were honored guests instead of lazy spongers. Other cuckoo tribes resort to even a lower form of sponging. These watch around until some busy little mason-bee matron gets her nest well-nigh completed and provisioned; then, during her last trip for the final load of provender, they steal into the burrow and lay their eggs in the cell.

Unconscious of what has happened, poor Mrs. Mason-bee lays her egg and closes the cell. But the cuckoo-bee's eggs hatch first, and its larva, eating the ration that never was intended for it, presently grows strong enough to overpower and devour the rightful owner of the cell.

Some species of mason-bees, realizing the purposes of the cuckoos who flourish by nimble wit, never lay an egg in a cell without first having in their mouths the mortar with which to close the cell. If they had to gather the mortar after laying the egg, the plunderer would be the first to improve the opportunity of crossing the unguarded threshold and laying her own eggs in it.

"With the industrious folk who go quietly about their business—the laborers, masons, foragers, and warehousemen—mingle the parasitic tribe, the prowlers hurrying from one home to another, lying in wait at the doors, watching for an opportunity to settle their families at the expense of the honest toilers."

In those words Fabre sums up the situation in Bee Land. Then, bringing the detached view of the philosopher to man's own attitude toward other creatures, he makes one a little more patient with these home destroyers of the insect world by saying, "Life in general is but a vast brigandage.

"Nature devours herself; matter is kept alive by passing from one stomach to another. At the banquet of life, each is in turn the guest and the dish; the eater of to-day becomes the eaten of to-morrow. Everything lives on that which lived or has lived; everything is parasitism. Man is the great parasite, the unbridled thief of all that is fit to eat. He steals the milk from the lamb, he steals the honey from the children of the bee, even as the Melecta bee pilfers the pottage of the Anthophora bee's sons."

The species reproduced are: *Crocisa crucifera* Ckll. (Plate XII, figure 3), occurring in the Philippine Islands; *Triepeolus quadrifasciatus* Say. (Plate XII, figure 11), inhabiting North America.

Anthophora Bee Family (*Anthophoridae*). This family of bees is widely distributed throughout the world. In North America nearly 100 species have been described, but the habits of only a few of these have been studied. The nests of familiar species usually are built in steeply inclined or perpendicular banks of earth, preferably in those of compact clay. Nearly all of the species are gregarious, hundreds of individuals building their nests close together in the same bank of earth. In the construction of their homes the Anthophoras build a cylindrical tube of clay, extending outward and downward from the entrance of the tunnel.

The outside of this tube is rough, but the inside smooth. It is composed of small pellets of earth compacted together, which have been brought out of the tunnel when wet and molded into the desired form. In excavating the tunnel the bees find the clay hard, so they visit a watering place and convert themselves into insectean tanks to carry sufficient supply to the burrow to soften the clay and make it workable like putty.

The Anthophora bees have many foes, before whose attacks they are practically helpless.

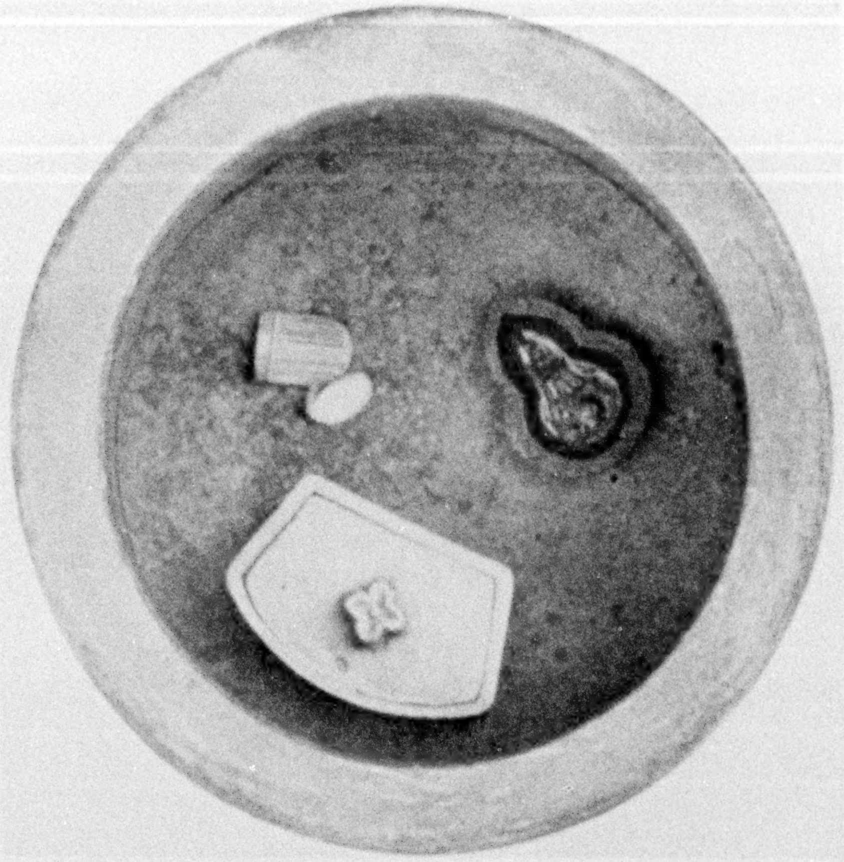
The species reproduced is *Anthophora zonata* Linn. (Plate XII, figure 5), found in southern Asia, Malay Peninsula, and Philippine Islands.

TRUE FLIES

(Order *Diptera*)

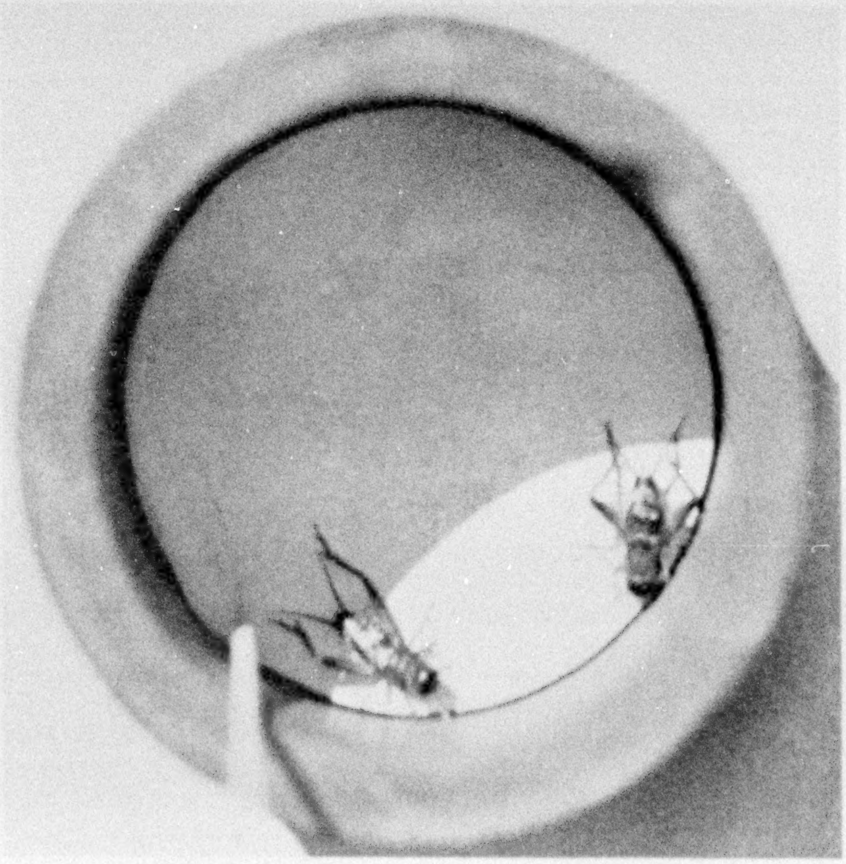
Plate XIV

This large order of insects embraces all the two-winged flies, which include the horse



A CHINESE CRICKET ARENA

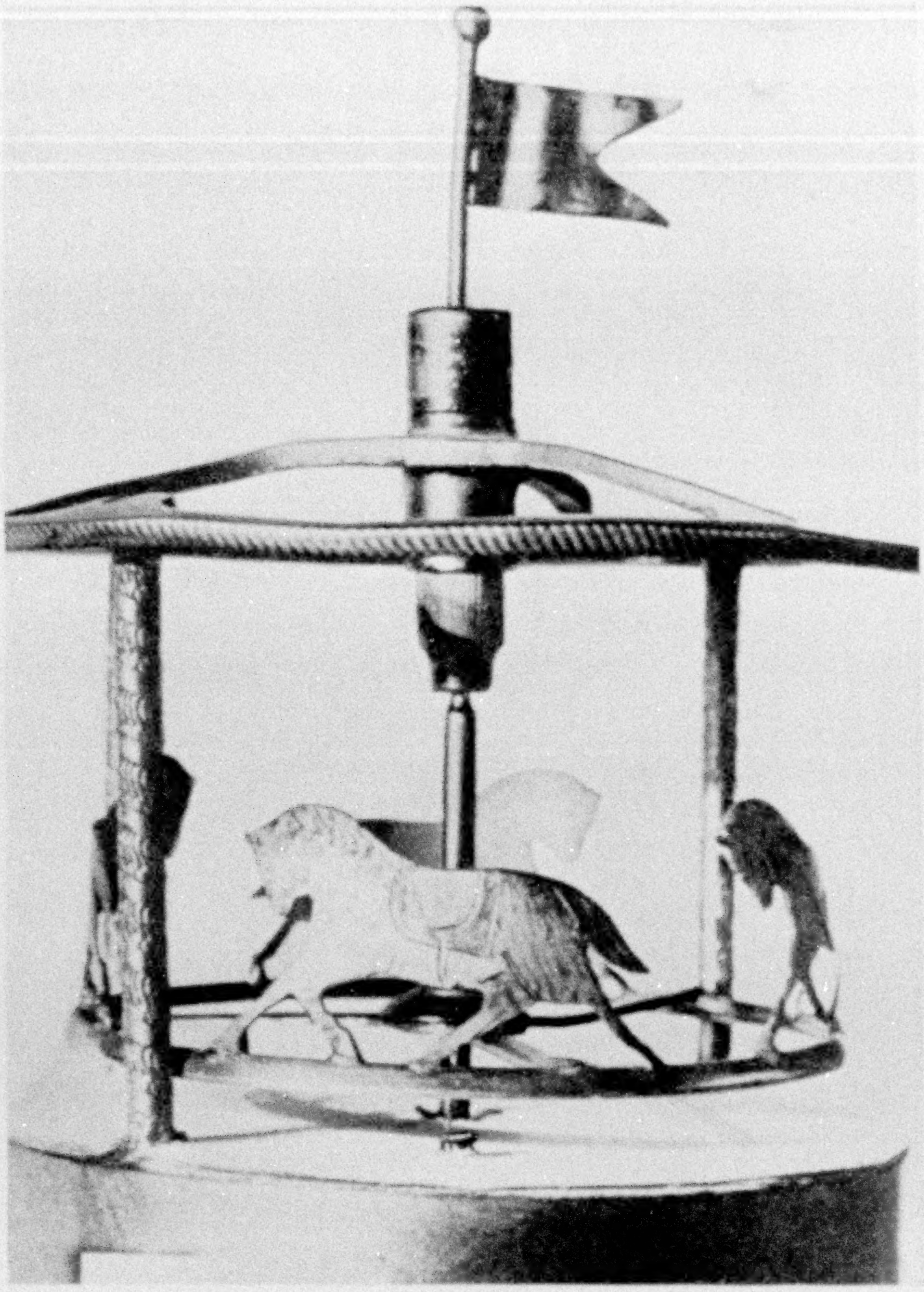
In the bowl is the cricket house with the lid on, at the upper left a food rack with a bean lying beside it, and at the upper right a water trough (see, also, page 63).



Photographs by James Dorsett

CRICKET GLADIATORS

The fighting ring is made of a portion of a large bamboo culm. Betting in China on the results is as lively as that at a horse race or at a game of *jai alai* in Cuba.



Photograph by International

A CHINESE MERRY-GO-ROUND DRAWN BY A FLEA

The tiny bit of motive power is seen in the foreground, under the rim of the wheel. Harnessed to the little toy, the insect is able to move eleven hundred times its own weight. In the United States men have trained fleas to draw tiny wagons and to do acrobatic stunts that make the flea circus a fascinating vaudeville performance.

flies, house-flies, blow-flies, mosquitoes, midges, and gnats, as well as a host of related families. According to Sharp, about 40,000 species have been discovered, but these are only a tithe of those still unknown to science. Aldrich's list of American species now goes far beyond the 8,000 mark.

The *Diptera* are rated by some authorities as physiologically the most advanced of the insects; certainly in them the processes of a complete life cycle are carried on with the greatest rapidity, and the phenomenon of metamorphosis has been most nearly perfected.

A maggot hatching from an egg grows so rapidly that it is mature in a few days; then within an impenetrable skin it dissolves itself almost completely. A little later the liquid content of that skin turns to a sort of jelly, and in a few days this is reconstructed into a being so totally different in appearance, in habits, and in structure, that the resources of science find themselves severely taxed to demonstrate any identity in the organs of the two stages of the insect's existence.

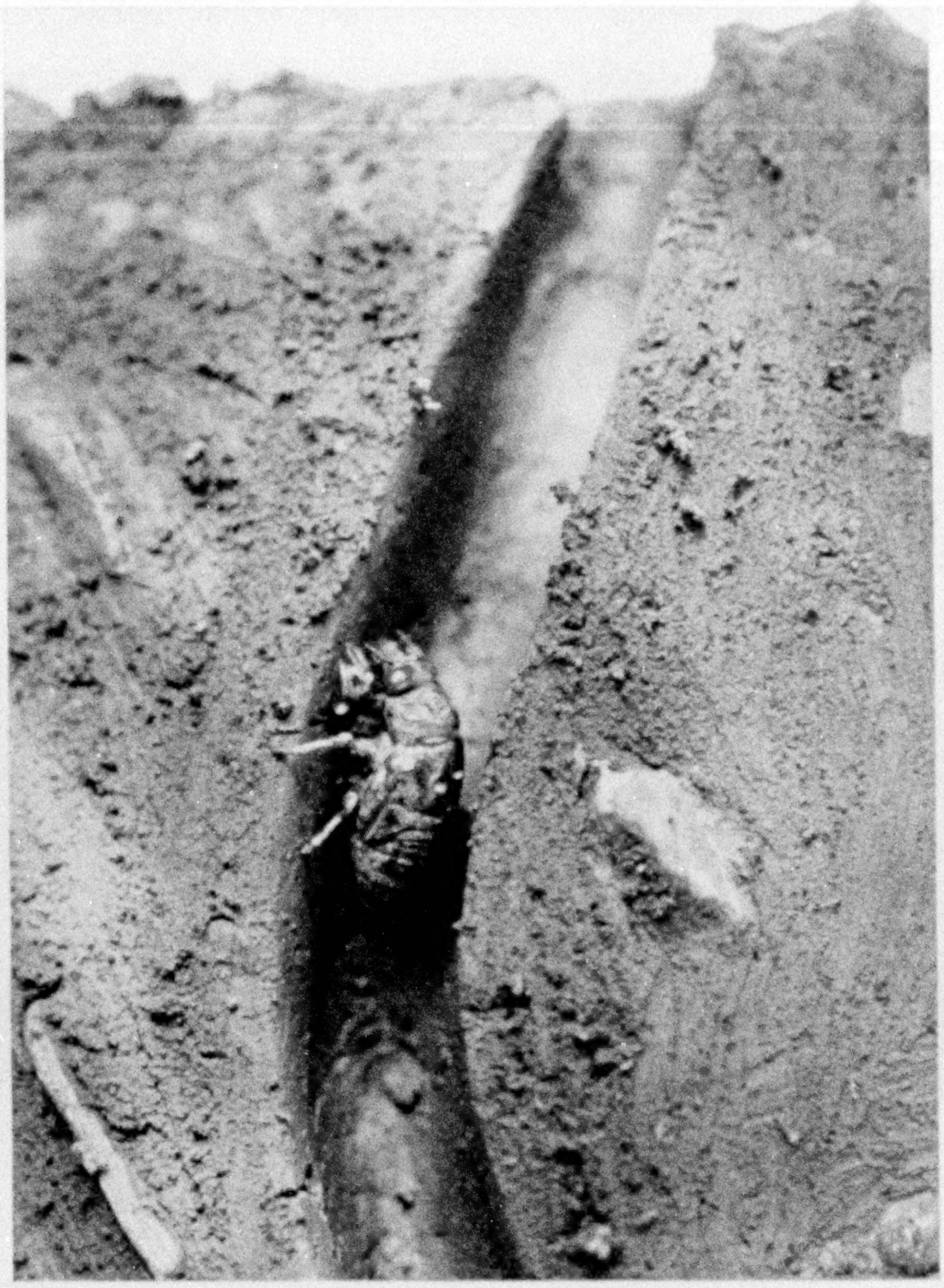
Hover Fly Family (*Syrphidae*). This family is one of the largest and best known among the flies. We see them in our garden, where, when the sun is bright, they hover over flowers or beneath trees where the sun finds its way through the leaves. Many of them mimic bumble-bees, others pattern after honey-bees, and still others imitate the wasps.

It is said that the old myth about the carcasses of animals generating swarms of honey-bees probably arose from the fact that one species of this family so closely resembles the drones that they have been taken for honey-bees. That species breeds in carcasses, and its mistaken identity is found in China and Japan, as well as in Russia. Even the Book of Judges in the Old Testament shows this error of identification in the story of Samson. The majority of species, however, are content to play the simple rôle of an ordinary fly.

The family embraces some 3,000 species distributed all over the world, of which about 300 are represented in our American fauna. Some species live as guests in ants' nests and others dwell with bumble-bees.

The species reproduced are: Tropical Hover Fly (*Volucella obesa* Fab. Plate XIV, figure 1), common throughout the American Tropics; Florida Ant Fly (*Microdon fulgens* Wiedemann. Plate XIV, figure 3), occurring in Florida; Eastern Hover Fly (*Temnostoma excentricum* Harris. Plate XIV, figure 9), living in the eastern part of the United States; *Milesia virginiensis* Drury. (Plate XIV, figure 10), inhabiting the eastern United States.

Pyrgota Fly Family (*Pyrgotidae*). The members of this family, by many authorities,



Photograph by Paul Henri Fabre

THE LARVA OF A CICADA IN ITS BURROW

The females of innumerable species of insects lay their eggs in the ground. When these hatch the larvæ dig themselves burrows in which they remain, usually until a short time before they are ready to develop wings and fly away in the adult stage of their life cycle. Many other species lay their eggs in fruits, nuts, and branches. When these fall to the ground the larvæ emerge and dig into the soil, where they make cells in which they sleep until the metamorphosis is complete.

are placed in the family of Ortalids. Some species of the family are parasitic upon various beetles.

The species reproduced is: May Beetle Fly (*Pyrgota undata* Wiedemann. Plate XIV, figure 2), parasitic upon the May beetle and found in the eastern United States.

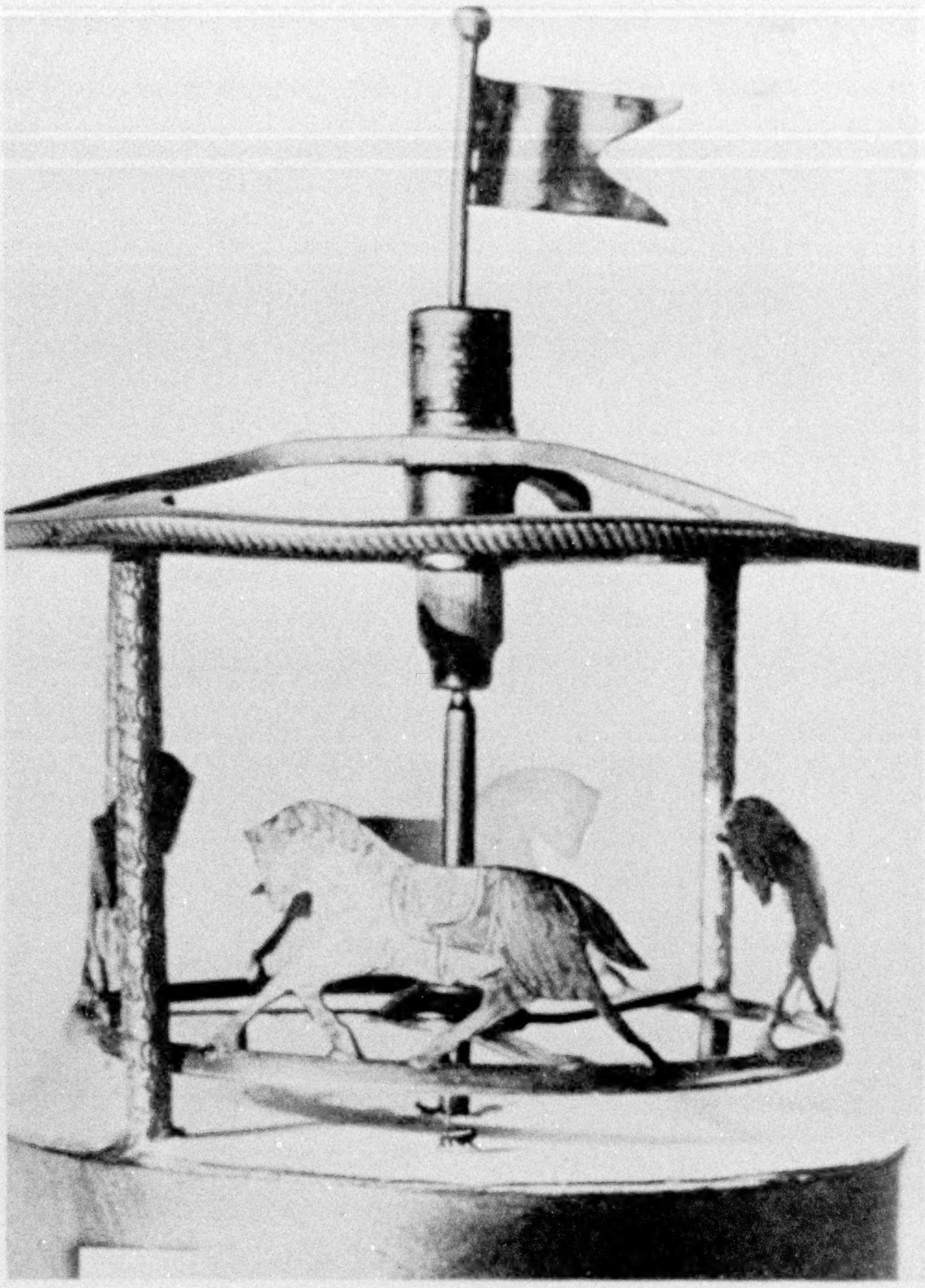
Tachina Fly Family (*Tachinidae*). There is no family of the fly order to which man is more deeply indebted than to the Tachina. Its species are practically all parasitic in their habits. Frequenting the flowers and vegetation where other insects gather, they watch their chance to attach their eggs to the skins of young caterpillars and grubs.

When these eggs hatch, the larvæ bore into their victims and live on the tissues. Sometimes the victim is killed before pupation, but usually the parasite's attacks are not fatal so soon, and pupation takes place. Later the parasite grub itself pupates within the carcass of its victim and then emerges a full-fledged fly. Many species of this family help to hold in check the great hosts of army-worms, locusts, and other of our worst insect foes, which otherwise would overwhelm a community. A single species is almost the only check on the destructive flower-eating Diabrotica of California, which, Kellogg tells us, if allowed to increase unhindered, soon would destroy every blossom in that land of flowers.

More than 1,400 American species have been reported in our fauna. Some species give birth to live larvæ instead of laying eggs. The skin of the prospective host is punctured by the viviparous female with her ovipositor and her larvæ deposited within the body of the host. In the case of *Eupeleteria magnicornis*, which infests the larvæ of the brown-tail moth, the female attaches its larva to the surface of a leaf by a thin membranous case which is cup-shaped and surrounds the anal end of the larva. The little maggot reposes on the silken thread which the caterpillar uses as a guide back to its nest, lying in wait until the victim returns from the feeding ground.

The species reproduced are: Eastern Tachina Fly (*Belvesia bifasciata* Fab. Plate XIV, figure 4), occurring in eastern and southern United States; Western Tachina Fly (*Paradejeania rutiloides* Jaennicke. Plate XIV, figure 5), inhabiting the western part of the United States.

Bot Fly Family (*Oestridae*). Although this family consists of fewer than 100 species in the whole world, it is one of much interest on account of the habits of its members, which, though large in size, live entirely at the ex-



Photograph by International

A CHINESE MERRY-GO-ROUND DRAWN BY A FLEA

The tiny bit of motive power is seen in the foreground, under the rim of the wheel. Harnessed to the little toy, the insect is able to move eleven hundred times its own weight. In the United States men have trained fleas to draw tiny wagons and to do acrobatic stunts that make the flea circus a fascinating vaudeville performance.

flies, house-flies, blow-flies, mosquitoes, midges, and gnats, as well as a host of related families. According to Sharp, about 40,000 species have been discovered, but these are only a tithe of those still unknown to science. Aldrich's list of American species now goes far beyond the 8,000 mark.

The *Diptera* are rated by some authorities as physiologically the most advanced of the insects; certainly in them the processes of a complete life cycle are carried on with the greatest rapidity, and the phenomenon of metamorphosis has been most nearly perfected.

A maggot hatching from an egg grows so rapidly that it is mature in a few days; then within an impenetrable skin it dissolves itself almost completely. A little later the liquid content of that skin turns to a sort of jelly, and in a few days this is reconstructed into a being so totally different in appearance, in habits, and in structure, that the resources of science find themselves severely taxed to demonstrate any identity in the organs of the two stages of the insect's existence.

Hover Fly Family (*Syrphidae*). This family is one of the largest and best known among the flies. We see them in our garden, where, when the sun is bright, they hover over flowers or beneath trees where the sun finds its way through the leaves. Many of them mimic bumble-bees, others pattern after honey-bees, and still others imitate the wasps.

It is said that the old myth about the carcasses of animals generating swarms of honey-bees probably arose from the fact that one species of this family so closely resembles the drones that they have been taken for honey-bees. That species breeds in carcasses, and its mistaken identity is found in China and Japan, as well as in Russia. Even the Book of Judges in the Old Testament shows this error of identification in the story of Samson. The majority of species, however, are content to play the simple rôle of an ordinary fly.

The family embraces some 3,000 species distributed all over the world, of which about 300 are represented in our American fauna. Some species live as guests in ants' nests and others dwell with bumble-bees.

The species reproduced are: Tropical Hover Fly (*Volucella obesa* Fab. Plate XIV, figure 1), common throughout the American Tropics; Florida Ant Fly (*Microdon fulgens* Wiedemann. Plate XIV, figure 3), occurring in Florida; Eastern Hover Fly (*Temnostoma excentricum* Harris. Plate XIV, figure 9), living in the eastern part of the United States; *Milesia virginiensis* Drury. (Plate XIV, figure 10), inhabiting the eastern United States.

Pyrgota Fly Family (*Pyrgotidae*). The members of this family, by many authorities, are placed in the family of Ortalids. Some species of the family are parasitic upon various beetles.

The species reproduced is: May Beetle Fly (*Pyrgota undata* Wiedemann. Plate XIV, figure 2), parasitic upon the May beetle and found in the eastern United States.

Tachina Fly Family (*Tachinidae*). There is no family of the fly order to which man is more deeply indebted than to the Tachina. Its species are practically all parasitic in their habits. Frequenting the flowers and vegetation where other insects gather, they watch their chance to attach their eggs to the skins of young caterpillars and grubs.

Photograph by Paul Henri Fabre

THE LARVA OF A CICADA IN ITS BURROW

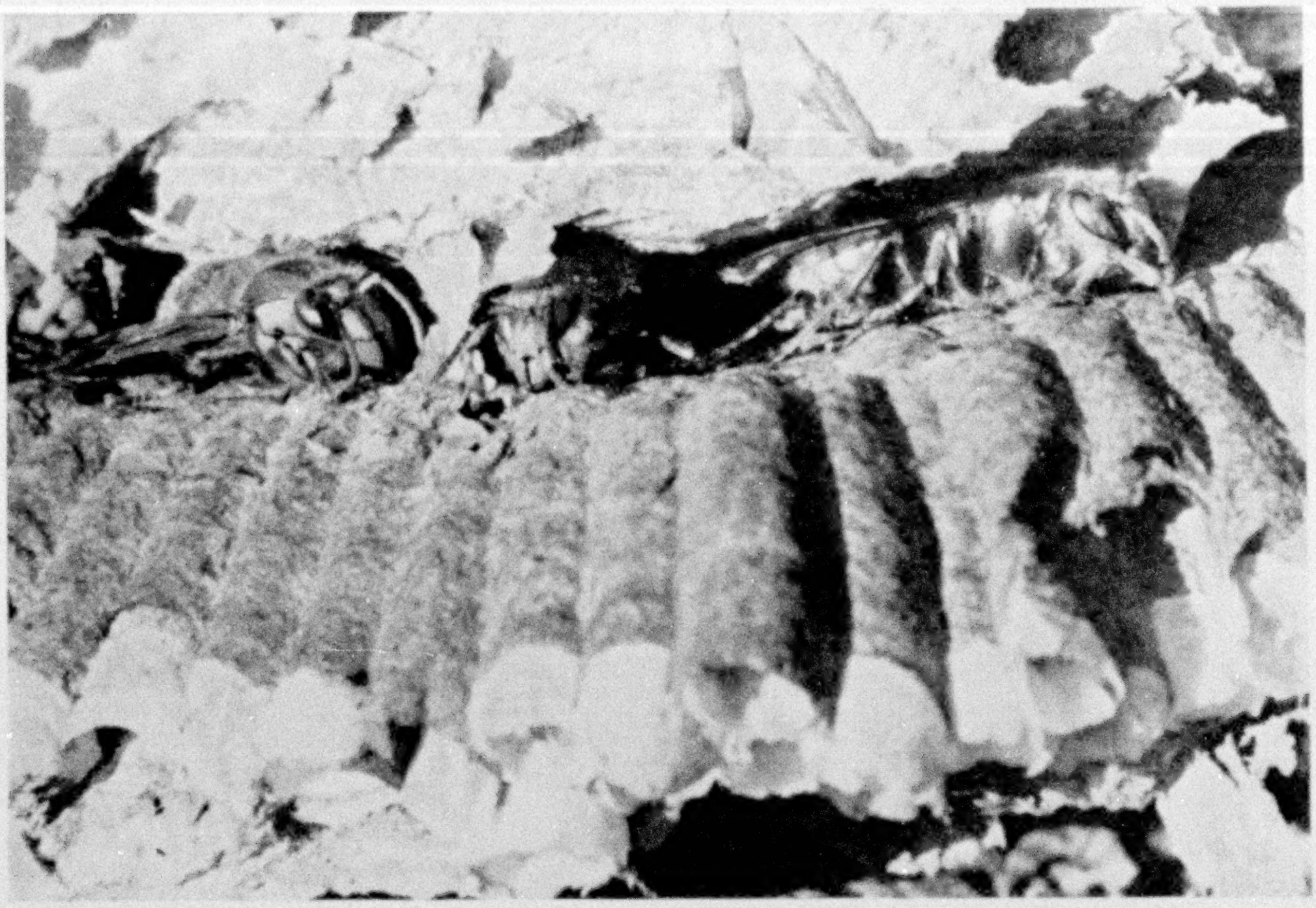
The females of innumerable species of insects lay their eggs in the ground. When these hatch the larvæ dig themselves burrows in which they remain, usually until a short time before they are ready to develop wings and fly away in the adult stage of their life cycle. Many other species lay their eggs in fruits, nuts, and branches. When these fall to the ground the larvæ emerge and dig into the soil, where they make cells in which they sleep until the metamorphosis is complete.

When these eggs hatch, the larvæ bore into their victims and live on the tissues. Sometimes the victim is killed before pupation, but usually the parasite's attacks are not fatal so soon, and pupation takes place. Later the parasite grub itself pupates within the carcass of its victim and then emerges a full-fledged fly. Many species of this family help to hold in check the great hosts of armyworms, locusts, and other of our worst insect foes, which otherwise would overwhelm a community. A single species is almost the only check on the destructive flower-eating Diabrotica of California, which, Kellogg tells us, if allowed to increase unhindered, soon would destroy every blossom in that land of flowers.

More than 1,400 American species have been reported in our fauna. Some species give birth to live larvæ instead of laying eggs. The skin of the prospective host is punctured by the viviparous female with her ovipositor and her larvæ deposited within the body of the host. In the case of *Eupeleteria magnicornis*, which infests the larvæ of the brown-tail moth, the female attaches its larva to the surface of a leaf by a thin membranous case which is cup-shaped and surrounds the anal end of the larva. The little maggot reposes on the silken thread which the caterpillar uses as a guide back to its nest, lying in wait until the victim returns from the feeding ground.

The species reproduced are: Eastern Tachina Fly (*Belvesia bifasciata* Fab. Plate XIV, figure 4), occurring in eastern and southern United States; Western Tachina Fly (*Paradejeania rutiloides* Jaennicke. Plate XIV, figure 5), inhabiting the western part of the United States.

Bot Fly Family (*Oestridae*). Although this family consists of fewer than 100 species in the whole world, it is one of much interest on account of the habits of its members, which, though large in size, live entirely at the ex-



Photograph by Lynwood M. Chace

BLACK-AND-WHITE PAPER WASPS IN THE DARK CORRIDORS BETWEEN TIERS OF CELLS

The wasps never have been able to solve the problem of a year-to-year existence of their colonies, as have some of the bees and ants. Each fall the community dies out, and only a few fertilized females, which have hibernated as adults in sheltered places, such as crevices in stone walls and protected spots under logs, are able to survive the winter. When spring comes these reawaken into an active life and make themselves small nests containing a few brood cells. From these humble beginnings the summer colonies grow.

pense of living vertebrates. Some dwell in the alimentary canals of their hosts, others occupy the respiratory passages, and still others live beneath the skin of the animals they attack. Some species of the bot fly family in the Tropics are parasitic on monkeys and even have been reared from human beings.

The Ox Warbles are aliens from Europe. They attach their eggs to cattle, usually on the hind legs and occasionally on the flanks. When the larvæ hatch they crawl down the hair follicle and penetrate the skin. In their second stage they are found in the wall of the esophagus. The exact course from the hind legs to the esophagus has not been determined, but it is believed that the larvæ probably travel in the loose connective tissues under the skin to the region of the throat and into the esophagus. Here they remain for three months and then migrate to the back, where they finally emerge through holes in the skin.

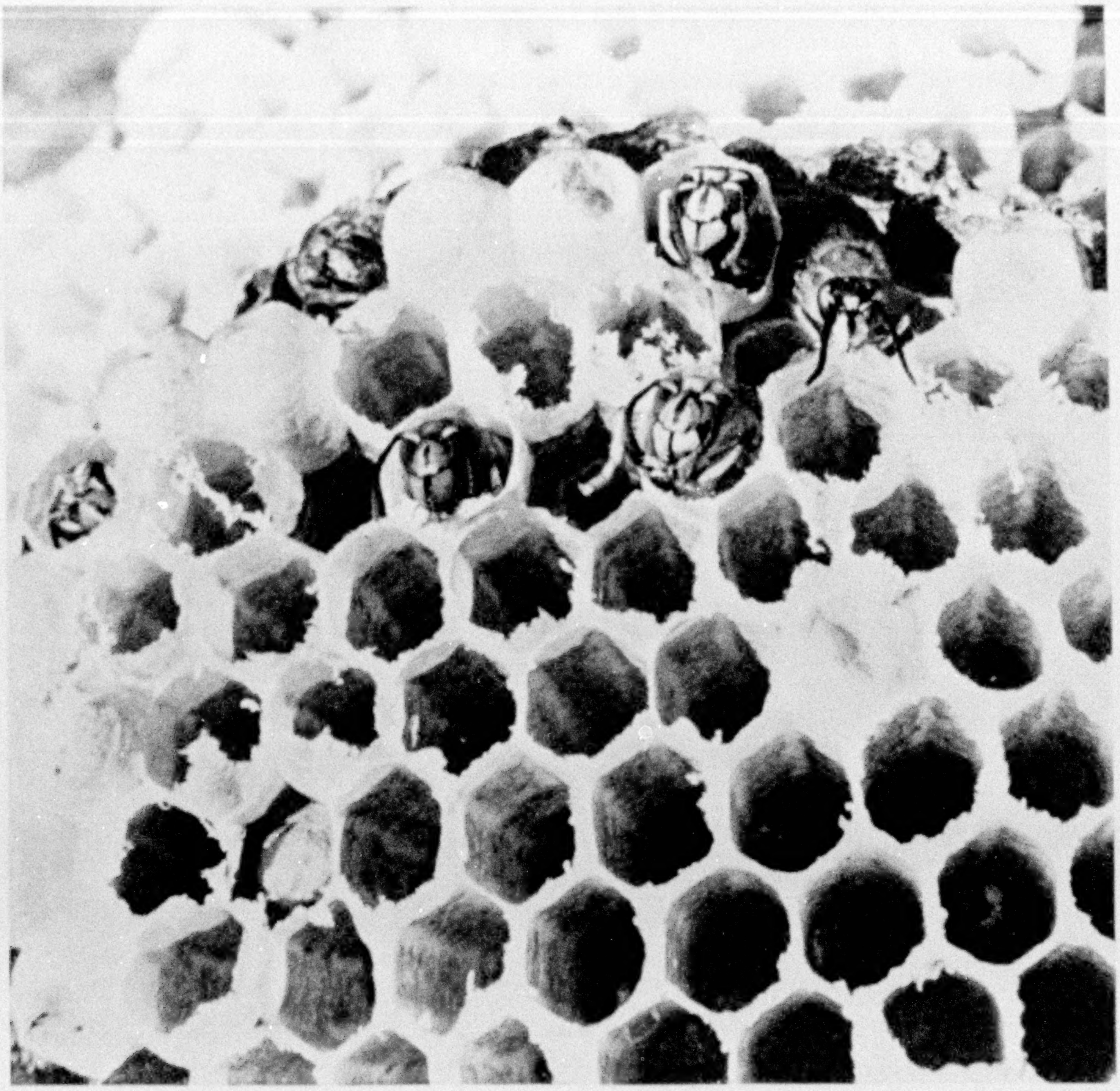
The horse bot fly is well known to every lover of horseflesh. During the summer time it flies about the forelegs of horses, laying its eggs on the long hairs above and below the knee joints.

These eggs rarely hatch when left untouched, but the horse, by scratching the legs with its teeth, removes the small cap of the eggshell and inadvertently takes the larvæ into its mouth. The latter then are carried with food or water into the stomach, where they fasten themselves to the inner coating and remain until full grown. Horses have an instinctive fear of the gad fly, as the adult more popularly is called.

The species reproduced are: Central American Bot Fly (*Dermatobia hominis* Linn. Plate XIV, figure 6), habitat Central America; Ox Warble (*Hypoderma lineatum* DeVilliers. Plate XIV, figure 8), occurring in eastern and southern United States.

Blow-fly Family (*Calliphoridae*). The most familiar members of this group are the blue-bottle and green-bottle flies. The blow-flies live normally out-of-doors, but often enter houses in search of material on which to deposit their eggs. Their larger size and loud buzzing, as well as their striking hues, make them conspicuous in any fly company. They lay their eggs on meat, cheese, and other provisions. These soon hatch and their larvæ rapidly develop.

It seems rather strange that until only a few centuries ago maggots were supposed to be the product of spontaneous generation. Then some early scientist decided to spread a piece of fly



Photograph by Lynwood M. Chace

CELLS OF A BLACK-AND-WHITE PAPER WASP

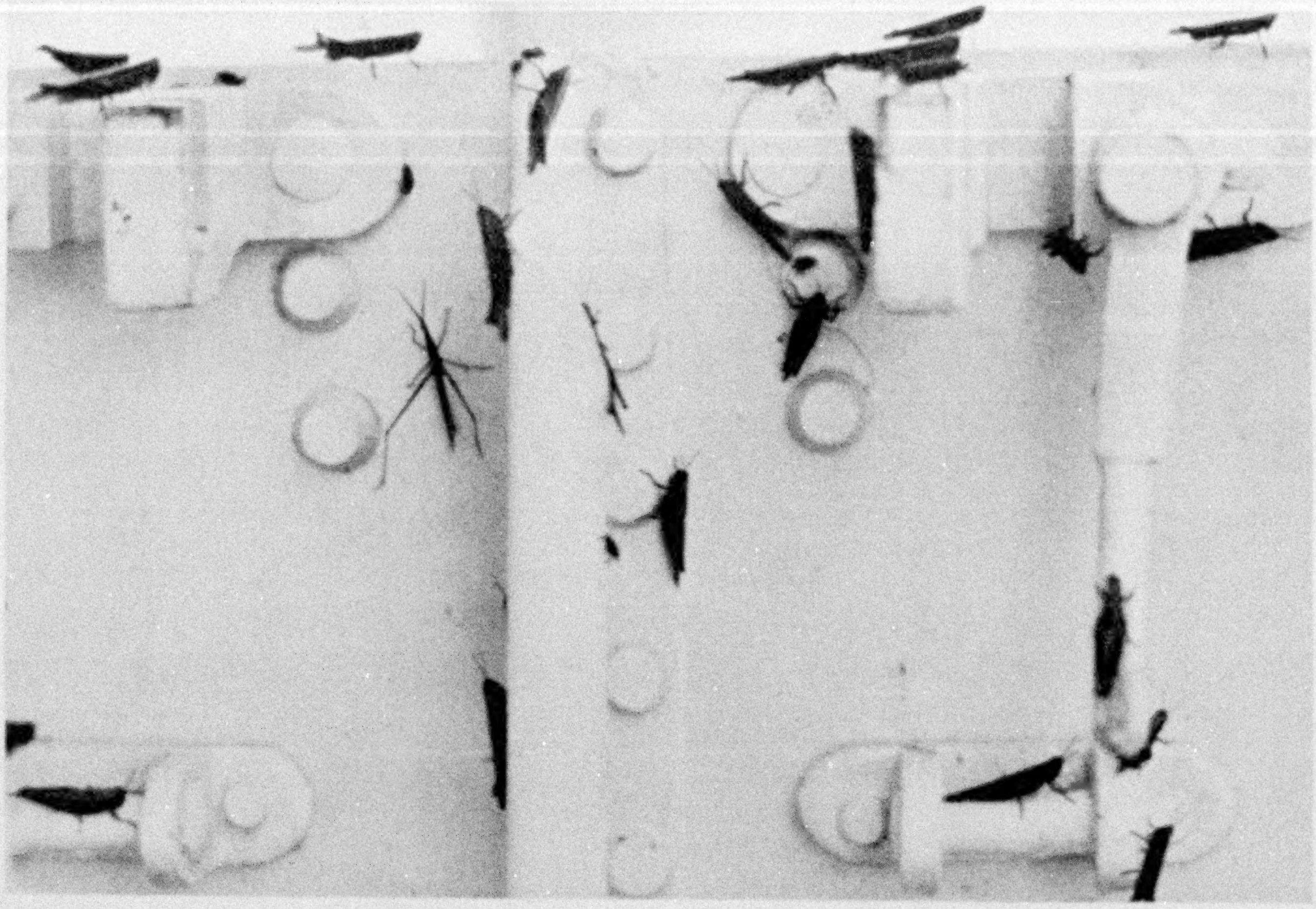
From some of the cells the young wasps have emerged, in others they are getting their first view of the world round about, and in still others the occupants remain undisturbed by the events of their community. The seals of their living tombs have not yet been broken, but presently the day of emergence will arrive, and, biting away the coverings, they will come forth full-panoplied for a short and merry life of a few weeks.

netting above a block of cheese so that the flies could hover about the cheese but not reach it. They thereupon laid their eggs upon the netting and these in due time produced the usual larvæ of maggots, and the ghost of spontaneous generation was banished for a long time. But when bacteria were discovered it came back, and so strenuously asserted itself that faith in it was held firmly in many quarters until Pasteur, through a long series of experiments, thoroughly put it to rout as an explanation even of the minutest form of life.

The species reproduced are: Scavenger Fly (*Silbomyia fuscipennis* Fab. Plate XIV, figure 7), from Java; Costa Rican Blow-fly (*Mesembrinella umbrosa* Aldrich. Plate XIV, figure 14), from Costa Rica.

Robber Fly Family (*Asilidae*). More than 3,000 robber fly species have been described, of which 500 are found in our fauna. Some are short, thick, and extremely hairy, superficially resembling bees and bumble-bees, but the majority of them are long and slender. As is the case with most insects which feed upon other insects, the robber flies are a ravenous host. A single individual has been observed to kill eight moths in 20 minutes.

They are fierce foes and seem to fear nothing. The stronger species will attack wasps and other stinging insects, and have been observed to capture dragon-flies and tiger-beetles. The larvæ of most species are like the adult flies in their predaceous habits. They feed upon



Photograph by Herbert

GRASSHOPPER GUESTS OF THE U. S. S. "MINDANAO"

When America's new Yangtze River gunboat reached a point a thousand miles from the Yellow Sea, a huge swarm of grasshoppers swooped down, rested a while, and then took wing again. Many species of insects have colonized the whole world by becoming stowaways aboard the ships that sail the seven seas.

other larvæ in rotting wood, under bark or fallen leaves, or in loose soil.

The species reproduced is: California Robber Fly (*Laphria coquilletti* McAtee. Plate XIV, figure 11), found in California.

Nimble Fly Family (*Dexiidae*). This family possesses about 50 species in this country. The legs of the American species are usually long, and in their early stages our nimble flies are parasitic on various insects, especially beetles. Snails also are known to be forced to act as hosts for their larvæ.

The species reproduced is: Australian Nimble Fly (*Rutilia splendida* Donovan. Plate XIV, figure 12), found in Queensland, Australia.

Ortalid Family (*Ortalidae*). This is a small family which possesses a number of American species. In the larval state they usually occur under the bark of pine and poplar trees, in the burrow of wood-boring insects, and in onions, cotton bolls, and apples. Most species are regarded merely as scavengers, but some are parasitic on caterpillars.

On the whole, the American Ortalids are a group of insects that have few foes and many friends.

The species reproduced is: *Achias amplividens* Walker. (Plate XIV, figure 13), occurring in Australia.

THE LITTLE MOTHS

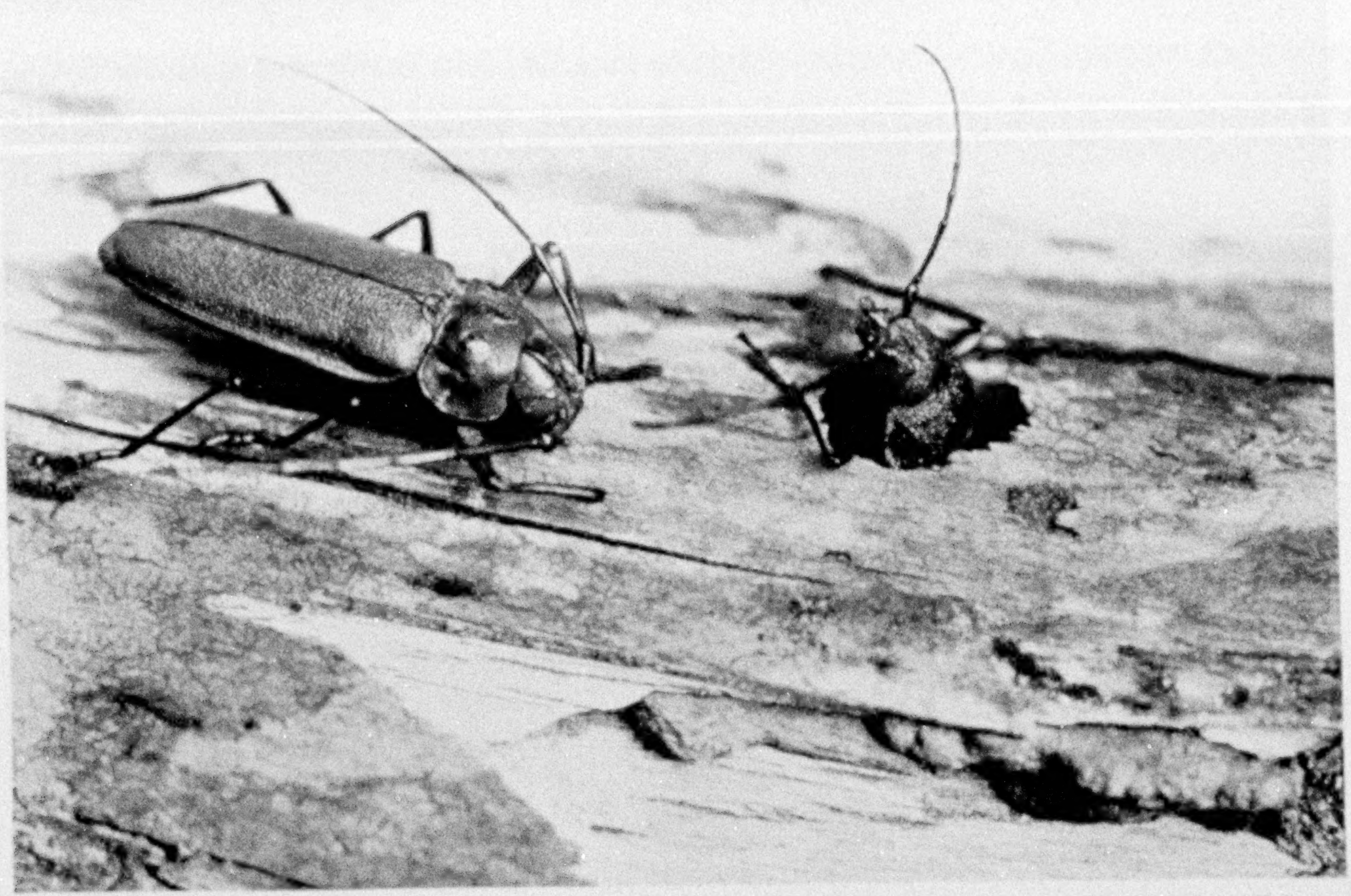
(Order *Micro-lepidoptera*)

Plates XV and XVI

Among the *Micro-lepidoptera* are some of the worst pests of the whole insect world. The Psyche moth, which in its larval stage is known as the bagworm, belongs to this order. So do the green slug-moth, with its bright scarlet caterpillar; the hag-moth, which gets its name from the disheveled appearance of its larva; the raspberry root-borer and the peach-tree borer, which are such foes of the berry patch and the peach orchard; the bee-moth, the flour- and meal moths, the clothes-moth, the codling moth, and many others of their ilk.

Olethreutidae Family. More than 400 North American species of this family have been described. Perhaps its most disliked member is the codling moth, whose larvæ are the nasty little worms too frequently found feeding near the core of apples. The grape berry moth, which is the most common cause of "wormy" grapes, also belongs to this group, as do the apple bud moth and the clover seed moth.

The species reproduced are: European Pine Shoot Moth (*Rhyacionia buoliana* Schiffermuller. Plate XV, figure 1), a native of Eu-



Photograph by Paul Henri Fabre

LONG-HORNED BEETLES ON A LOG

Some wood-boring beetles spend their larval stage in the heart of oak trees, while others spend this period driving mines between the bark and the wood. The latter species are known as engraver beetles. One tiny member of the order has been a source of much trouble to transcontinental telephone cables. They bore through the lead sheathing, thereby admitting moisture and destroying the insulation.

rope, also found in New York; Virginia Pine Moth (*Petrova virginiana* Busck. Plate XV, figure 3), found in Virginia and eastern United States; *Grapholitha egregiana* Felder. (Plate XV, figure 16), found in the Solomon Islands.

Oecophoridae Family. The *Oecophoridae* moths embrace about 100 American species of rather diverse habits, most of which, in their larval stages, live in webs or feed in decayed wood. Perhaps the most familiar species is the parsnip web moth, whose larvæ web together and devour the unfolding flower heads of celery, parsnip, and wild carrot. After having consumed the flowers and unripe seeds and become nearly full-grown, they burrow into the hollow stems of the plants, feed upon the pith and then pupate.

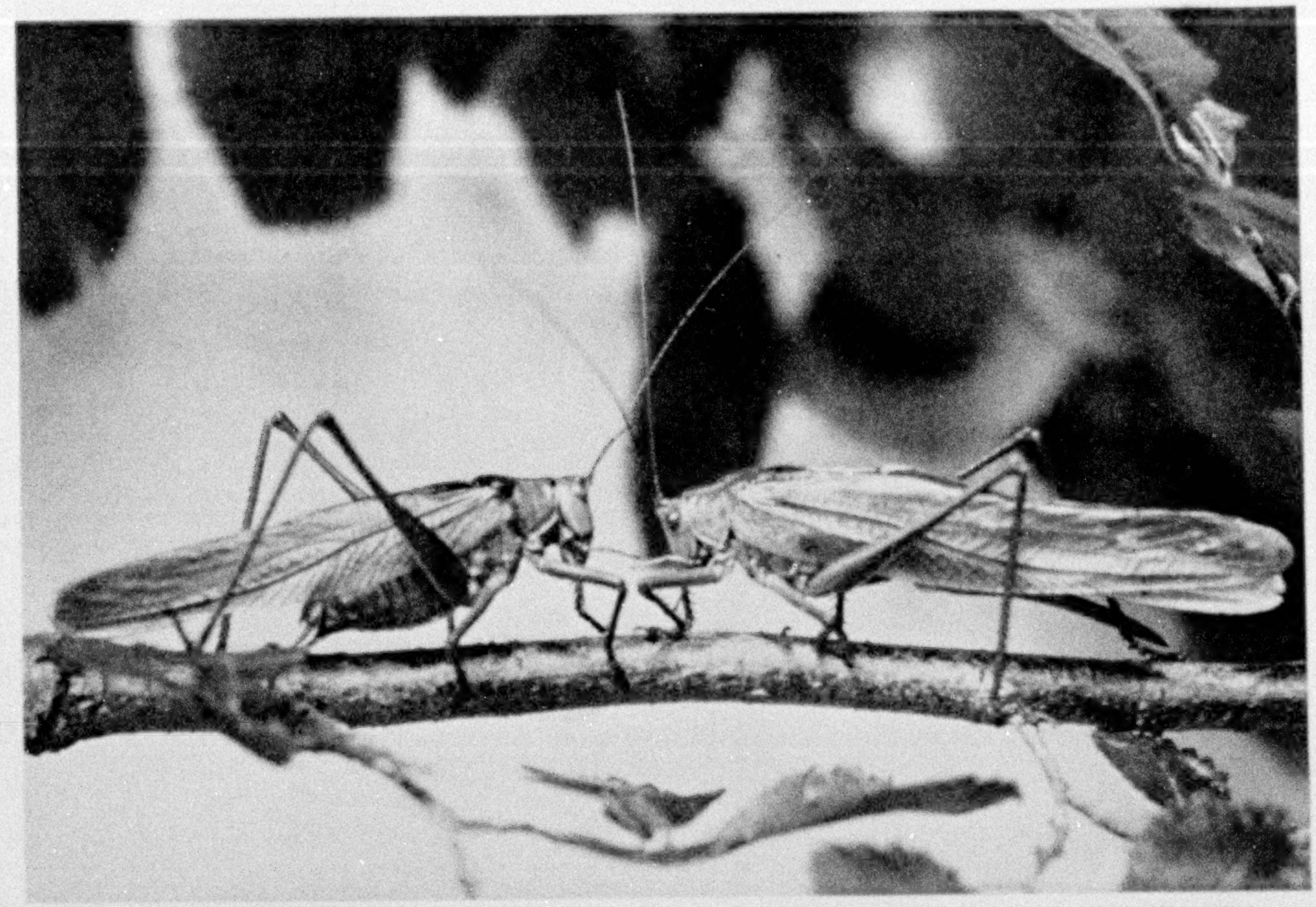
The species reproduced are: *Lupercalia ignita* Busck. (Plate XV, figure 2), occurring in Panama; *Filinota hermosella* Busck. (Plate XV, figure 6), habitat French Guiana; *Phytomimia chlorophylla* Walsingham. (Plate XV, figure 18), inhabiting Guatemala; *Hypercallia miniata* Dognin. (Plate XVI, figure 4), habitat Ecuador.

Cosmopterygidae Family. In spite of the fact that this family has no common name, some of its members are well known. One of these is the Palmetto Leaf-miner, which lives on the saw palmetto. Its larvæ are social, working together in small companies. They make nests consisting of a delicate sheet of silk covering that part of the leaf upon which they are feeding. The cattail moth, which infests the heads of cattail plants, is another member.

The species reproduced are: *Psacaphora edithella* Barnes & Busck. (Plate XV, figure 4), occurring in Colorado; Palmetto Leaf-miner (*Homaledra heptathalama* Busck. Plate XV, figure 5), inhabiting Florida.

Gelechiidae Family. This family includes a number of our worst pests and possesses more than 400 species. Some are leaf-miners, others attack the heads and bolls of plants, and still others prey upon stored grain. The Angoumois grain-moth, whose larvæ feed within the seeds of oats, rye, wheat, barley, sorghum, and cow peas, and the pink boll worm, which is one of the worst of our insect pests, are the outstanding members of the family. The peach twig borer, which burrows into the tender shoots of the peach tree in early spring, and the goldenrod gall moth, whose larvæ cause the galls in the stems of goldenrod, also belong to this group of *Micro-lepidoptera*.

The species reproduced are: *Atasthalistis tricolor* Felder. (Plate XV, figure 7), living in



Photograph by Paul Henri Fabre

TWO INSECT WEATHER PROPHETS CONFER (SEE TEXT, PAGE 14)

These green grasshoppers are close relatives of the katydids. The males sing both by day and by night. The eggs of most species are laid usually in the stems of root leaves of grasses or the pith of twigs.

the Solomon Islands; *Atasthalistis concinnalis* Feisthamel. (Plate XVI, figure 3), occurring in New Guinea.

Hyponomeutidae Family. This is another family of *Micro-lepidoptera* which is somewhat noted for its pest species. One of them is the apple fruit miner, which has developed into a serious menace in orchards in western Canada. It burrows in all directions through the fruit, causing it to decay. The family also embraces the ailanthus web-worm moth and the ermine moth. One species of the latter has been introduced into the United States and is becoming an apple and cherry pest.

The species reproduced are: *Mieza citrina* Busck. (Plate XV, figure 8), living in Costa Rica; *Mieza laetae* Hubner. (Plate XV, figure 10), occurring in Guatemala; *Mieza spatula* Busck. (Plate XV, figure 11), living in Costa Rica; *Atteva exquisita* Busck. (Plate XV, figure 13), a native of Mexico; *Atteva hysginiella* Wallengreen. (Plate XV, figure 17), inhabiting the Galápagos Islands; *Atteva pustulella* Fab. (Plate XV, figure 20), an inhabitant of San Salvador; *Lactura conflagrans* Walker. (Plate XVI, figure 2), occurring in New Guinea; *Pseudotalara regia* Schaus. (Plate XVI, figure 5), occurring in Mexico.

Glyphipterygidae Family. This family is of world-wide distribution. There are about 40 species which belong to it in the North American fauna.

The species reproduced are: *Tortyra cuprinella* Busck. (Plate XV, figure 9), occurring in Panama; *Hemerophila albertiana* Stoll. (Plate XV, figure 12), native of British Guiana; *Mictopsichia durranti* Walsingham. (Plate XV, figure 19), native of Guatemala.

Adelidae Family. The tiny moths of this family in their larval stage feed on the leaves of various herbs and shrubs. In their earliest stages the larvæ are miners, but later they live in portable cases. The male members of the family are characterized by the unusually long and fine antennæ, which may be twice or more than twice the length of the wings.

The species reproduced is: *Nematois chrysoprasias* Meyrick. (Plate XV, figure 14), occurring in Assam.

Ethmiidae Family. The larvæ of this family are usually social, living in a light web and feeding chiefly on plants of the borage family. Most of the American species belong to the genus *Ethmia*.

The species reproduced is: *Ethmia festiva* Busck. (Plate XV, figure 15), found in Guatemala and Panama.

Tineidae Family. Some 4,000 species of this family, which includes among others the

Photograph by Paul Henri Fabre

A BEETLE DRAGS A CICADA INTO ITS BURROW

The most striking hunters of the insect world belong to the wasp clan. However, many of the beetles are also carnivorous.

clothes-moths and many of the leaf-miners, have been described, of which 125 have a North American habitat. Each of the three species of clothes-moths belongs to a different genus, and all of them came with the American people from the Old World. One of them is the parent of the case-bearing larva.

Whenever this larva grows too large for its little case, it expands its home without emerging therefrom. Cutting a triangular slit down one side, in the one end it inserts triangular gores of the woolen material upon which it is feeding, after which it turns around and enlarges the other end in the same way. That process takes care of the diameter, but not the length of the case. To make it longer, each end is opened and an addition is built.

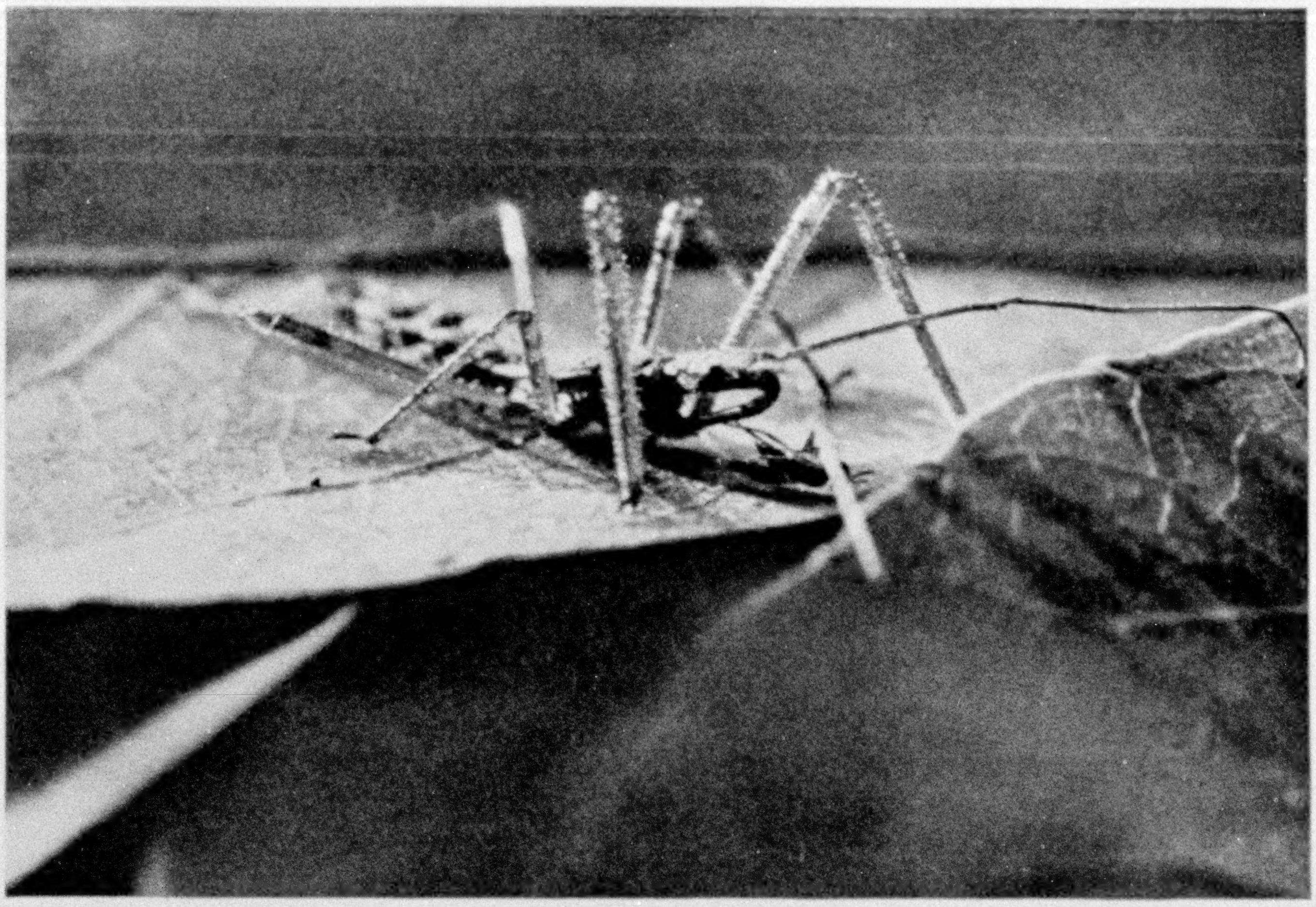
The web clothes-moth makes no case, but hides in a fold or crevice of the material it is eating and spins a little web of silk to cover it. The third species is found in fur robes, horse blankets, upholstering, and the like. Species of the genus *Stigmella* are mostly leaf-miners. The leaves of Juneberry, oak, chestnut, hazel, walnut, sycamore, ironwood, apple, wild cherry, sweetbrier, and blackberry each have their own special species of these miners.

The species reproduced is: *Coryptilum klugii* Zeller. (Plate XVI, figure 1), found in New Guinea.

Tortricidae Family. This large family, mostly made up of leaf-rollers, possesses about 165 North American species. The *Cacoecia* include the rose ugly nest, the cherry tree ugly nest, the oak ugly nest, and the fruit tree ugly nest, the latter being much of a nuisance in orchards. The eggs are laid on the bark of the twigs in June. The larvæ hatch in May of the following year and enter the opening buds.

The species reproduced are: *Cerace onustana* Walker. (Plate XVI, figure 6), found in Japan; *Pseudatteria leopardina* Butler. (Plate XVI, figure 7), occurring in Costa Rica; *Pseudatteria mimica* Felder. (Plate XVI, figure 9), habitat Brazil; *Megalodoris electrina* Meyrick. (Plate XVI, figure 12), living in the Philippine Islands; *Tortrix animosana* Busck. (Plate XVI, figure 14), occurring in Guatemala.

Clear Winged Moth Family (*Aegeriidae*). This is a small family of unorthodox *Microlepidoptera*, since many of them have no scales on their wings and some of them only a few. Likewise they depart from the moth habit in being day rather than night flyers. The majority of the species of the family mimic bees, wasps, and flies. This mimicry is not a superficial one, since even the motions of the insects captured or disturbed closely resemble those of the ones they imitate. Their attitude while resting, the sounds they produce, their hyaline wings, the rings on their bodies, even the odors they give off, stamp them as being what they are not. Some of them carry the deception so far that they even pretend to sting, and go



Photograph by Paul Griswold Howes

AN ASSASSIN-BUG FEEDING ON A CAPTURED INSECT

These hairy-legged creatures feed mainly on other insects, but have been known to bite human beings. The kissing bugs, which occupied so much space in the newspapers several decades ago, belong to this family. The hairs on their bodies are often sticky, and particles of dust, lint, and other material adhere to them, practically concealing them. Its appearance has given to one of the species the common name of masked bed-bug hunter (see text, page 41).

through all the motions of doing so, although they are entirely lacking in the necessary organ for that purpose.

The larvæ of the family are all borers. One of them, *Sanninoidae exitiosa*, is the worst of all the peach-tree borers, and is estimated to damage the peach crop to the extent of $6,000,000 a year. While it formerly preyed on wild cherries and plums, it later adopted the peach tree.

The species reproduced are: *Paranthrene palmi* Harry Edwards. (Plate XVI, figure 8), occurring in New York State; Western Clear Winged Moth (*Melittia gloriosa* Harry Edwards. Plate XVI, figure 11), living in Oregon.

Plutellidae Family. This family is of wide distribution, with about 50 North American species. The most familiar member is the diamond back moth whose larvæ infest cabbage and other cruciferous plants, eating holes in the leaves. The moth is sometimes a pest in greenhouses, infesting stocks, wallflowers, sweet alyssum, and candytuft.

The species reproduced is: *Imma grammozona* Meyrick. (Plate XVI, figure 10), habitat New Guinea.

Stenomidae Family. This family possesses some 20 North American species and has a rather wide distribution. The larvæ live in webs, most frequently infesting the oak.

The species reproduced are: *Stenoma elegans* Zeller. (Plate XVI, figure 13), occurring in Peru; *Stenoma armata* Zeller. (Plate XVI, figure 15), inhabiting Paraguay.

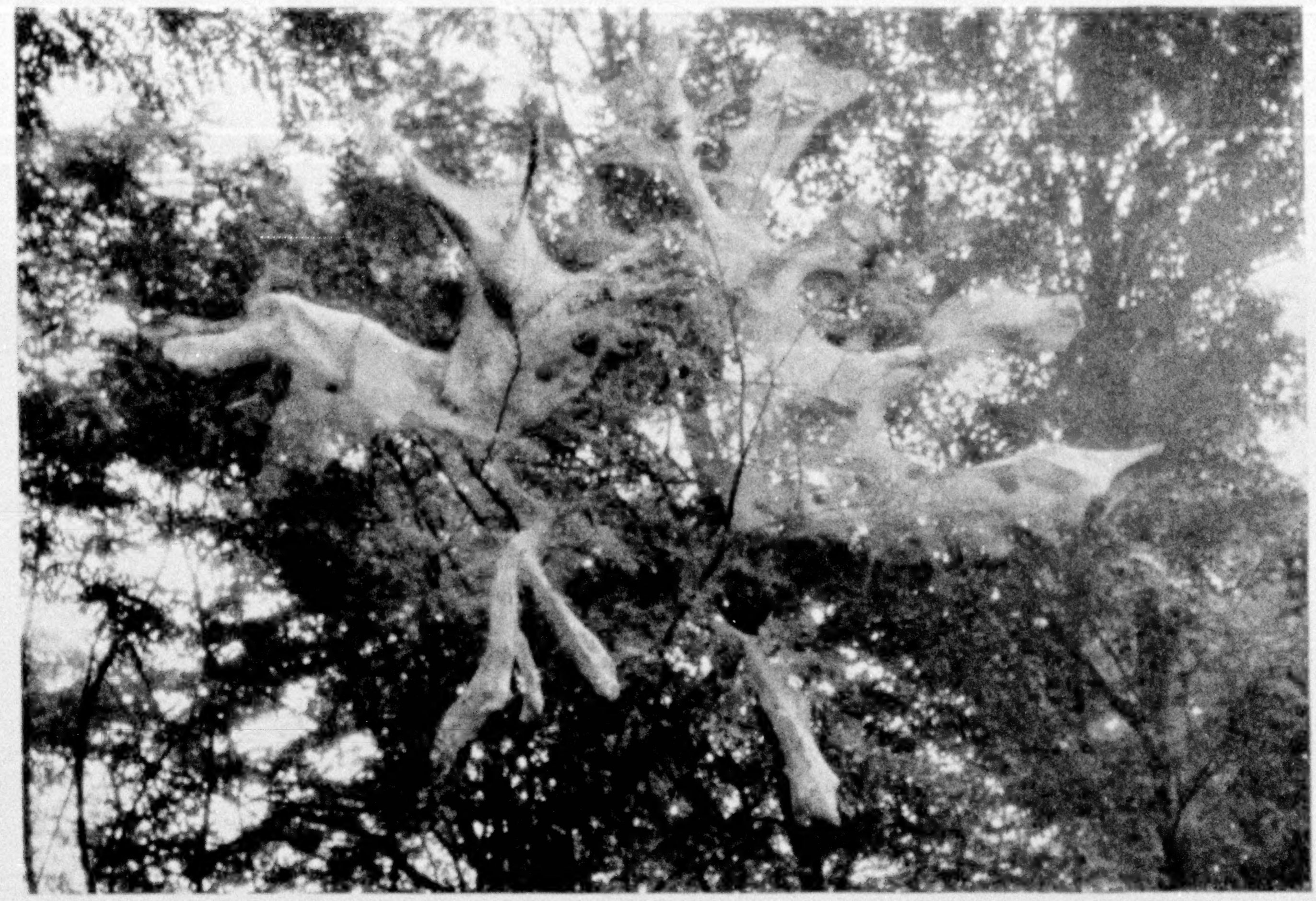
THE BEETLES

(Order *Coleoptera*)

Plates XVIII to XXIV inclusive

The beetles are the predominant order of the insect world. The transformation of what was once their forward pair of wings into wing cases makes them poor flyers, but it gives them a protection that has brought prosperity to their kind. The order consists of about 150,000 known species, which are grouped in upward of 80 families. Although representatives of nearly all of these families are to be found in our fauna, less than 40 families contain the species that are familiar to most of us. Among the families not illustrated are those to which belong the fireflies, curculios, bark-beetles, grain beetles, burying beetles, death-watch and drug-store beetles, rove beetles, water pennies, and whirligigs.

Tortoise Beetle Family (*Cassididae*). These beetles get their name from the striking



Photograph by George R. King

TENT-CATERPILLAR NESTS IN WESTCHESTER COUNTY, NEW YORK

The larvæ of many species of moths, butterflies, and *Micro-lepidoptera* are gregarious in their habits and build community nests, where they stay together until time to pupate. Then they become individualistic again and each goes its own way.

similarity of their shape to that of the tortoise. Many of them possess striking colors in life which incline to fade in death. To this family belong the striking argus and the brilliant gold-bug. Beautiful as are the adults, their grubs are ugly and disagreeable in the extreme. They possess taillike forks at the end of the body, upon which is heaped their excrement and cast skins, used as a sort of shelter.

Each successive molt brings a new cast skin to the shelter, which gradually comes to resemble a pack, so that the grubs become known as peddlers. The gold-bug seems to possess some of the characteristics of the chameleon. Sometimes it appears in a dull yellow costume and at others in an armor that shines like burnished gold. At still other times it is arrayed so that it presents the variable tints of pearls.

The species reproduced are: *Desmonota variolosa* Web. (Plate XVIII, figure 1), from Bahia; *Tauroma casta* Boh. (Plate XVIII, figure 4), native of Costa Rica; *Omaspides bistriata* Boh. (Plate XVIII, figure 15), occurring in Colombia, Venezuela, and Costa Rica; *Dolichotoma bisbiplagiata* Boh. (Plate XVIII, figure 16), habitat Guatemala; *Aspidomorpha miliaris* Fab. (Plate XVIII, figure 17), habitat the Philippines, New Guinea, Yünnan, and Tonkin; *Mesomphalia beatula* Boh. (Plate XVIII, figure 21), occurring in Brazil.

Leaf Beetle Family (*Chrysomelidae*). There are some 18,000 known species in this family, nearly 1,000 of which occur in our North American fauna. It includes the long-horned leaf beetles, the 3-lined potato-beetle, the asparagus beetle, the grape root worm, and the familiar Colorado potato beetle. The latter is the largest species of the family, and the damage it does to potato leaves is typical of the ravages of the family on different forms of foliage on which the several species feed.

The story of the spread of the Colorado beetle constitutes one of the most surprising adventures of an insect species in American entomological history. When civilization moved west to Colorado it found there, feeding on sand burs, a yellow- and black-striped beetle with a disgusting odor, but with no hint of its deadly possibilities.

About 1850 it began to cultivate a taste for potato leaves; nine years later it had spread to Nebraska, reached Iowa at the beginning of the Civil War, and crossed the Mississippi the summer that Lee surrendered at Appomattox. It then spread eastward, and by the centennial year had succeeded in forcing the barriers of the Alleghenies and reaching the Atlantic seaboard. Europe was heartily alarmed when a few of them sailed across the Atlantic as stowaways, but prompt preventive measures and rigid quarantine have prevented them from colonizing the world's principal potato-growing continents.

The species reproduced are: *Leptinotarsa 10-lineata* Say. (Plate XVIII, figure 2), habitat Canada to Costa Rica; *Leptinotarsa flavitarsis* Guer. (Plate XVIII, figure 3), occurring in Guatemala; *Lema trilineata* Oliv. (Plate XVIII, figure 9), habitat North America and the West Indies; *Doryphora flavozonata* Blanch. (Plate XVIII, figure 18), habitat Bolivia; *Doryphora kollari* Stal. (Plate XVIII, figure 19), occurring in Brazil; *Doryphora mirabilis* Stal. (Plate XVIII, figure 20), habitat Mexico and Guatemala; *Doryphora flavozonata* Blanch. (Plate XIX, figure 1), native of Bolivia; *Sagra Borneoensis* Lac. (Plate XIX, figure 2), native of Borneo, and ranging all through the oriental region; *Sagra fabricii* Lac. Plate XIX, figure 10), habitat Java.

Metallic Wood-borer Family (*Buprestidae*). There are some 5,000 known species of metallic wood-borers, or Buprestids, in the world, of which about 200 are found in America. Many of them are among our most showy beetles, their metallic wing cases often being rich in brilliant iridescence. The wing cases of some eastern species are a brilliant green, and are used for dress trimmings. South American Indian chieftains often make anklets of the bronze wing cases of a gigantic South American species.

The larvæ of the larger species of Buprestids are nearly all wood-borers. They usually live under bark, and make broad, shallow burrows, galleries, and chambers.

So regular are their habits of burrowing that a trained entomologist can recognize the species that made the traceries long after they are gone, just as a bank teller recognizes the signature of a customer. Their bodies are long, somewhat flattened, the forward segments so joined with the small head as to make them appear to possess large, flat heads—hence their popular name of hammer-heads and flat-headed borers.

The most injurious of the Buprestid beetles is the flat-headed apple-tree borer, which prefers apple trees, but makes itself at home in many other kinds. The adults appear about May, and are a dull, metallic brown, except the abdomen, which is a rich, metallic greenish blue. The young larvæ build their nests in the soft sapwood, but as they grow older, bore deeper into the heartwood where they hibernate. In the spring, they bore back almost to the surface, where they build their pupal cells in which to undergo the sleep out of which they shall awaken full-fledged beetles.

Another injurious Buprestid is the peach-tree borer. With wing cases that look like hammered copper, it is a beautiful creature. Still another is the red-necked cane-borer which causes the "gouty galls" on blackberries and raspberries. The adults emerge in May or June, and lay their eggs where the leaf axil joins the stem. Their larvæ girdle the stem, and by early August the galls begin to form, if the girdling operation has been successful.

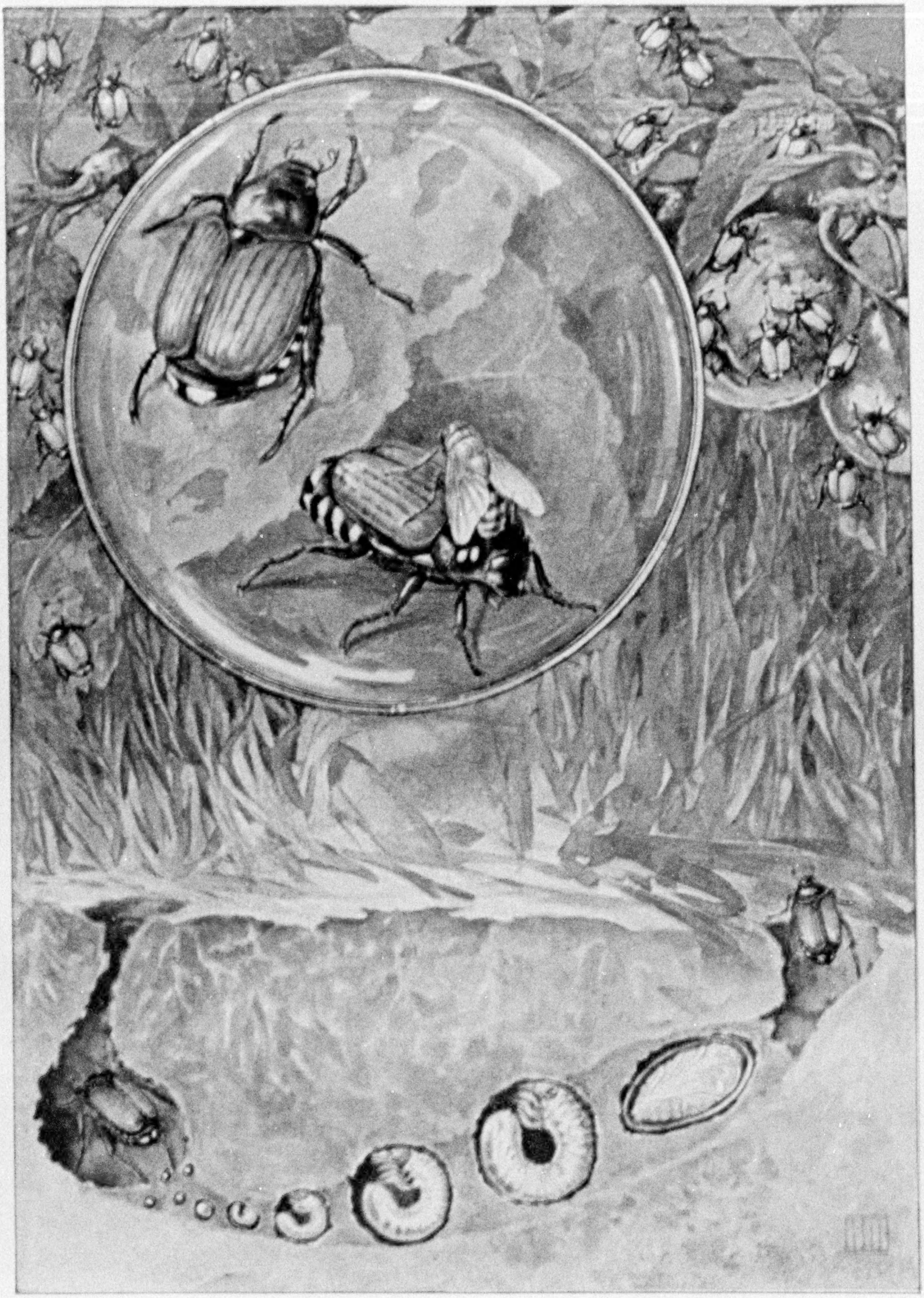
The larvæ spend the winter in the gall, or, if none has been formed, burrow into the pith of the brier stem. Many of the larger American Buprestids are particularly fond of pine trees, and prey on conifers exclusively. Some of the smaller species are leaf-miners.

The species reproduced are: *Chrysobothris femorata* Oliv. (Plate XVIII, figure 5), a North American species; *Julodis viridipes* Cast. (Plate XIX, figure 5), occurring in Africa; *Hyperantha haemorrhoa* Fairm. (Plate XX, figure 6), a South American species, living especially in Venezuela; *Psiloptera bicarinata* Thunbg. (Plate XX, figure 7), occurring in French Guiana; *Stigmodera variabilis* Don. (Plate XX, figure 8), habitat Australia; *Buprestis rufipes* Oliv. (Plate XXI, figure 2), habitat eastern United States; *Buprestis aurulenta* Linn. (Plate XXI, figure 3), occurring in northwestern United States; *Chrysochroa fulgidissima* Schoenh. (Plate XXI, figure 14), a Japanese species; *Sternocera benningseni* Kerrem. (Plate XXII, figure 1), habitat Africa; *Sternocera hunteri* Waterh. (Plate XXII, figure 3), habitat Africa; *Conognatha amoena* Kirby. (Plate XXII, figure 4), habitat Brazil; *Belionota sumptuosa* Cast. & Gory. (Plate XXII, figure 6), habitat Malaysia; *Chrysochroa buqueti* Gory. (Plate XXII, figure 7), habitat Indo-China and Java; *Chrysochroa edwardsi* Hope. (Plate XXII, figure 8), occurring in southern Asia; *Stigmodera macularia* Donovan. (Plate XXII, figure 9), habitat Australia; *Chrysochroa ocellata* Fabricius. (Plate XXII, figure 10), habitat southern Asia; *Stigmodera suturalis* Donovan. (Plate XXII, figure 11), an Australian species.

Meloid Beetle Family (*Meloidae*). The Meloid beetles, of which there are some 1,500 known species, including the 200 that are American, have a fascinating life history. Some species prey on bees, others on locusts, and still others on divers forms of insect life. The one parasitic on locusts lays its eggs in spots frequented by the locusts. In a few days these hatch, and the baby Meloes proceed early and actively with their prime business of finding a host. Crawling around in large numbers, locust egg deposits soon are found, and presently most of the eggs become provender for the wandering host. After a preliminary feast the youngster makes seven different changes before reaching the adult stage. At one point a change results in a retrogression in its climb to adulthood.

The species reproduced are: *Epicauta vittata* Fab. (Plate XVIII, figure 6), found in North America; *Tegrodera aloga* Skinn. (Plate XIX, figure 7), habitat California; *Zonabris oculata* Thunbg. (Plate XIX, figure 8), a South African species.

Long-horned Beetle Family (*Cerambycidae*). There are about 13,000 species of long-horned beetles in the world, of which some 600 belong to North America. They include such pests as the round-headed apple-tree borer, the oak pruner, and the twig girdler.



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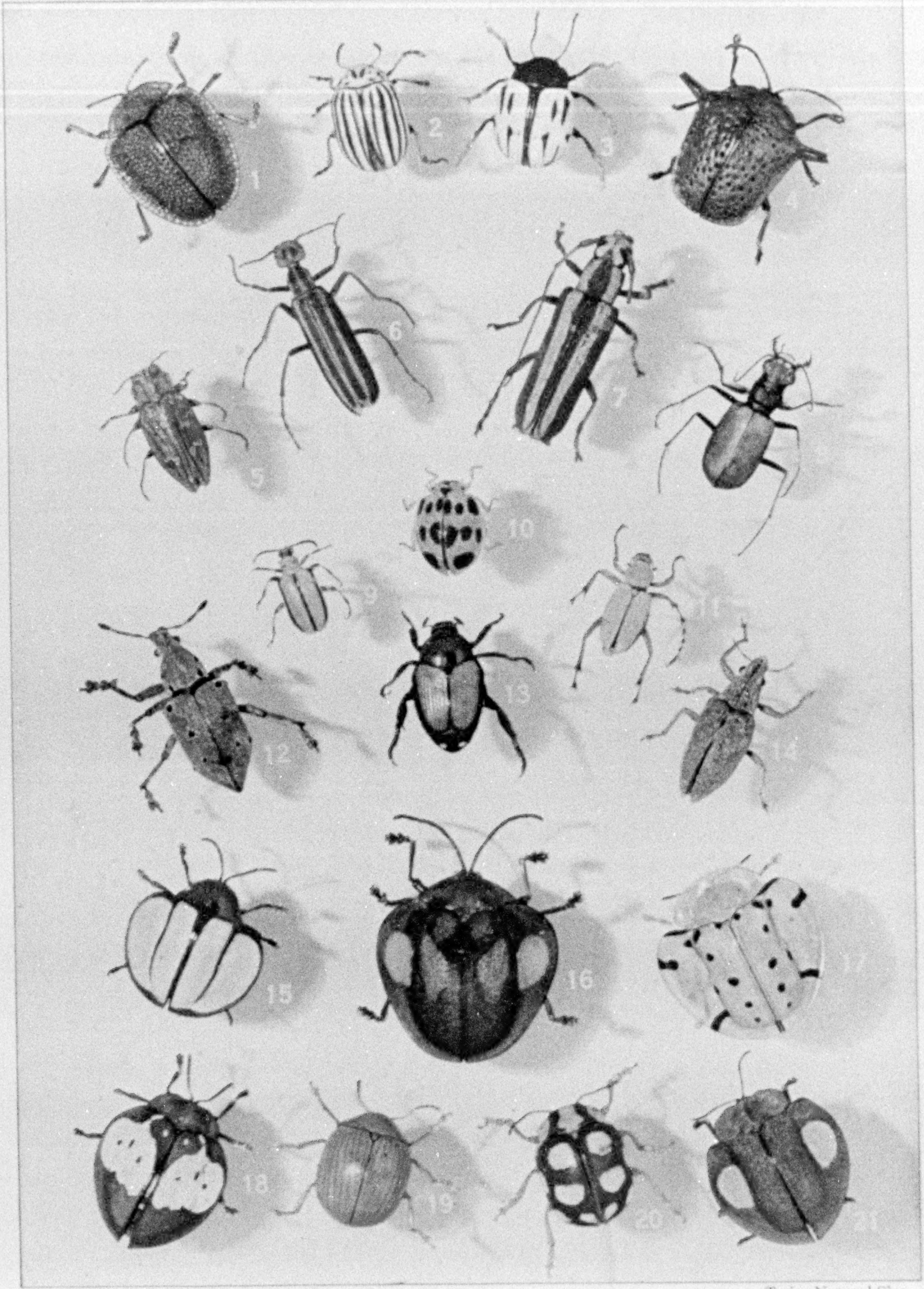
Painting by Hashime Murayama

THE JAPANESE BEETLE AND THE HIGH SPOTS OF ITS CAREER

The story of the career of this newest of our American pests is broadly typical of the whole Beetle Order. Not all of them spend their larval stages in the ground, however. The parasitic fly shown on the magnified female beetle was imported by the United States Bureau of Entomology. In Japan it and other parasites have been able to prevent the beetle from becoming a menacing pest. The entomological name of the Japanese beetle is *Popillia japonica* and of the fly parasitizing it *Centeter cinerea*. The beetles at the top of the main picture are natural size; those under the magnifying glass are 4½ times natural size; those at the bottom are 1½ times natural size.

XUM



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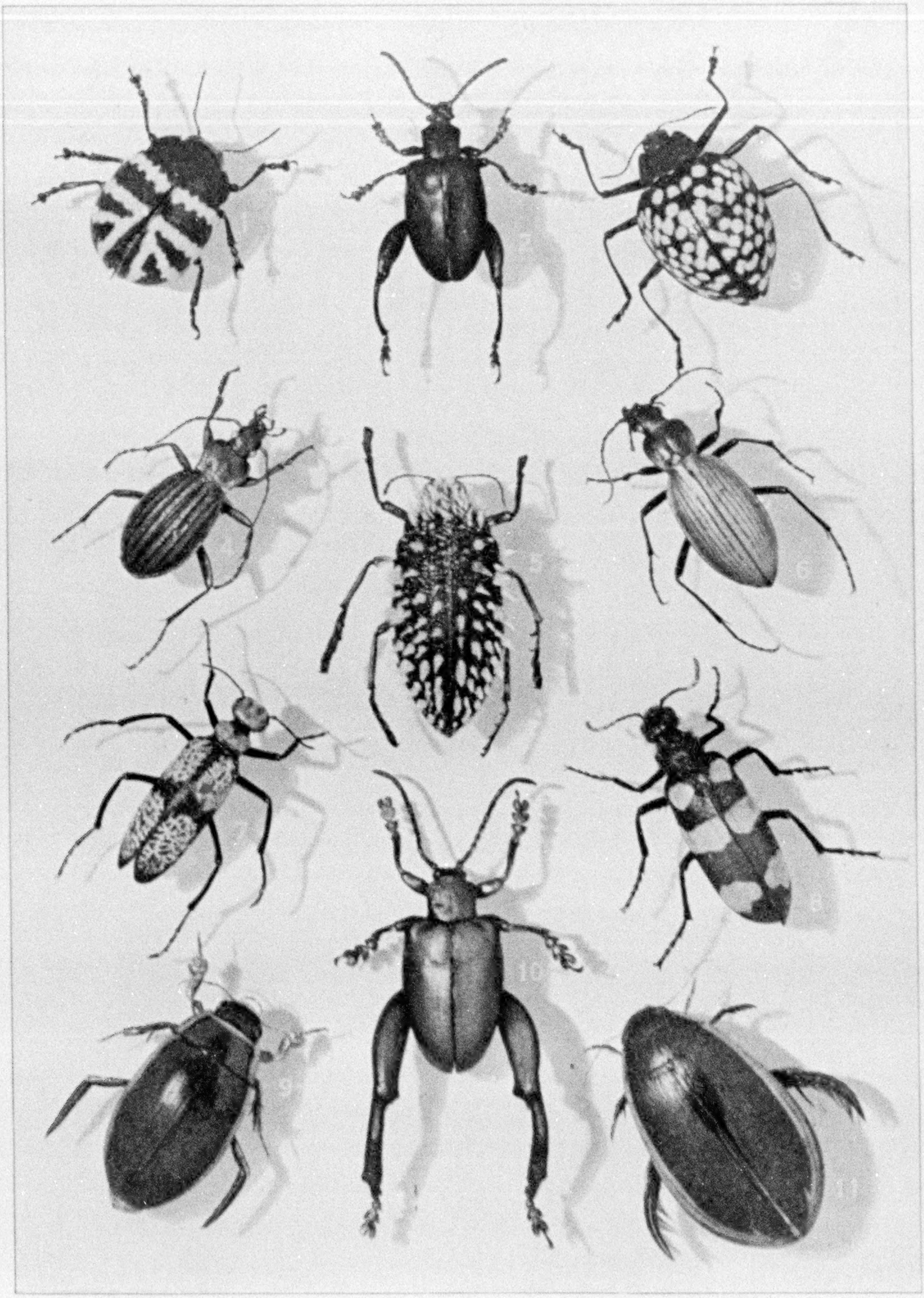
Twice Natural Size

LIVING JEWELS THAT MOCK THE LAPIDARY WITH THEIR BEAUTY

(1) *Desmonota variolosa* Web.; (2) *Leptinotarsa* 10-*lineata* Say; (3) *Leptinotarsa flavitarsis* Guer.; (4) *Tauroma casta* Boh.; (5) *Chrysobothris femorata* Oliv.; (6) *Epicauta vittata* Fab.; (7) *Saperda candida* Fab.; (8) *Cicindela scutellaris* Say; (9) *Lema trilineata* Oliv.; (10) *Epilachna borealis* Fab.; (11) *Macrodactylus angustatus* Beauv.; (12) *Cyphus* 16-*punctata* Linn.; (13) *Popillia japonica* Newman; (14) *Hypomeces squamosus* Fab.; (15) *Omaspides bistriata* Boh.; (16) *Dolichotoma bisbiplagiata* Boh.; (17) *Aspidomorpha miliaris* Fab.; (18) *Doryphora flavozonata* Blanch.; (19) *Doryphora kollari* Stal.; (20) *Doryphora mirabilis* Stal.; (21) *Mesomphalia beatula* Boh. See text under the following Family headings: Tortoise Beetle, Leaf Beetle, Metallic Wood-borer, Meloid Beetle, Long-horned Beetle, Tiger-beetle, Lady-bird Beetle, Scavenger Beetle and Leaf Chafer, and Snout Beetle.



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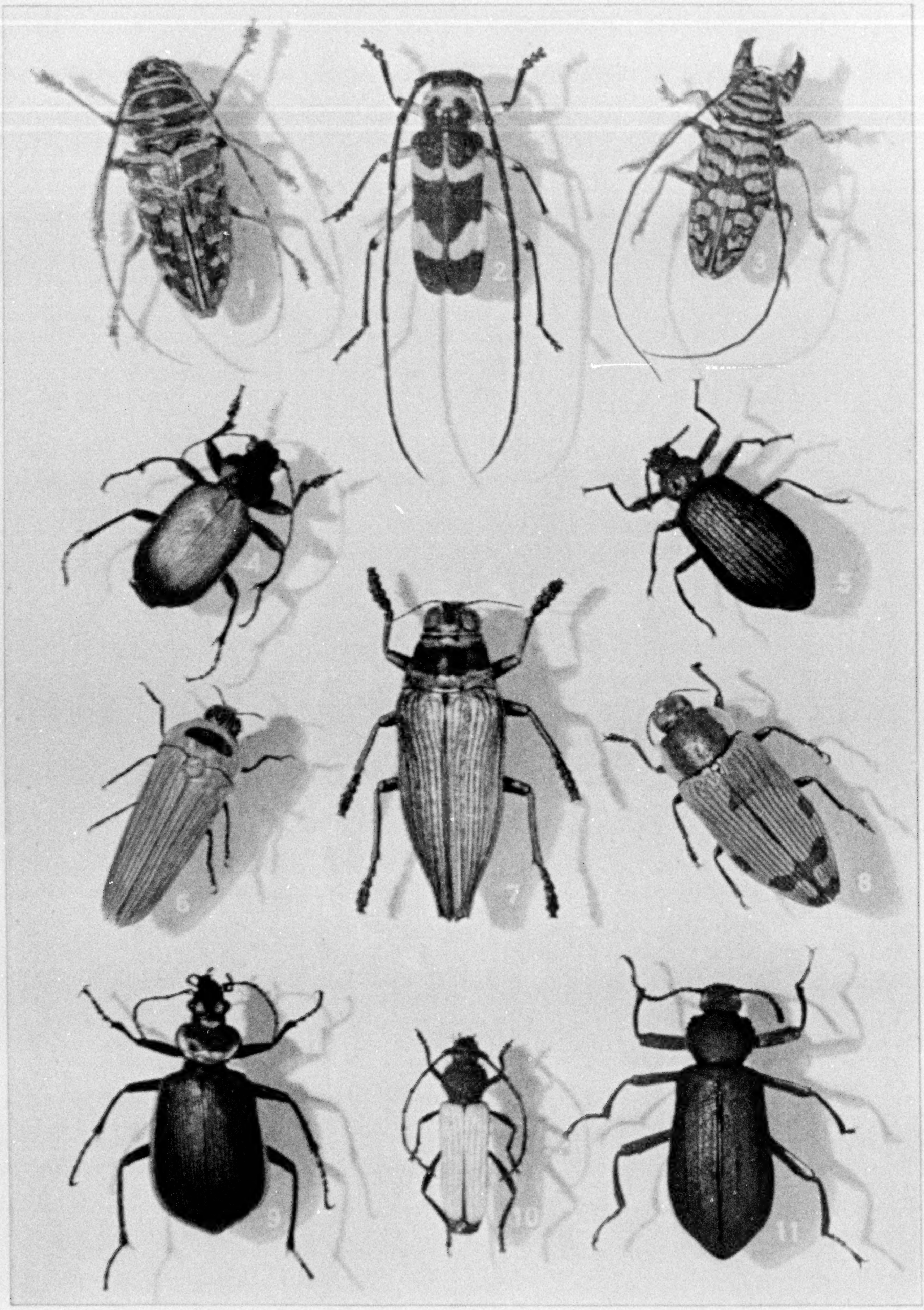
1¼ times Natural Size

BEETLES FROM MANY LANDS DISPLAY THE VERSATILITY OF THEIR ORDER

(1) *Doryphora flavozonata* Blanch. ; (2) *Sagra borneoensis* Lac. ; (3) *Erotylus giganteus* Linn. ; (4) *Carabus auronitens* Fab. ; (5) *Julodis viridipes* Cast. ; (6) *Ceroglossus gloriosus* Gerst. ; (7) *Tegrodera aloga* Skinn. ; (8) *Zonabris oculata* Thunbg. ; (9) *Dytiscus fasciventris* Say ; (10) *Sagra fabricii* Lac. ; (11) *Cybister fimbriolatus* Say. See text under the following Family headings: Leaf Beetle, Erotylidae Beetle, Ground-beetle, Metallic Wood-borer, Meloid Beetle, and Predaceous Diving Beetle. The Predaceous Diving Beetles and their kin are the principal foes of the larvae living at the bottom of ponds, creeks, and rivers. The Diving Beetles bear such a close resemblance to some of the diving insects of the Order *Hemiptera* that frequently they are confused with one another.



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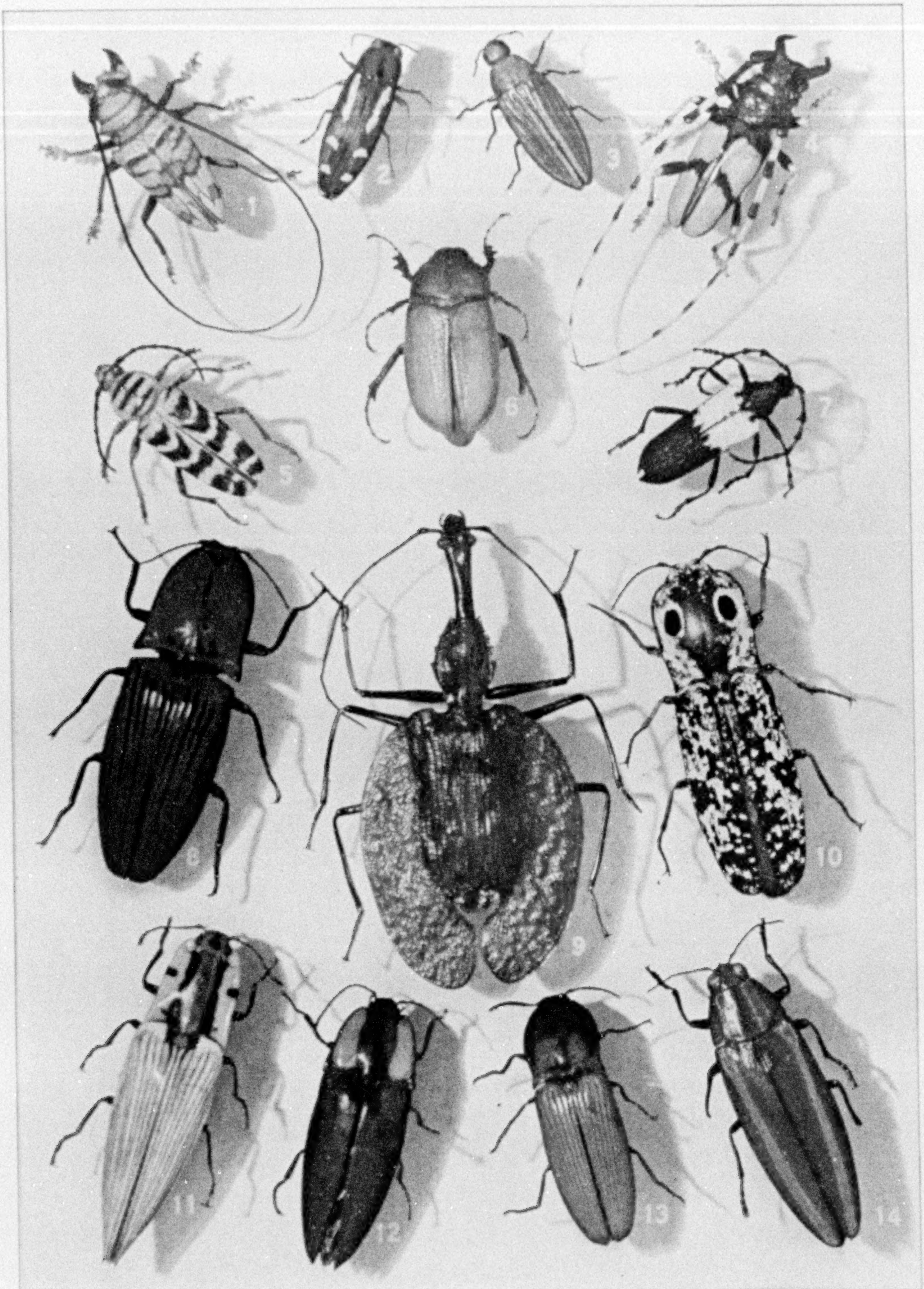
1¼ times Natural Size

A STRIKING GROUP OF WOOD BORING, GROUND-, AND DARKLING BEETLES

(1) *Sternotomis virescens* Westw.; (2) *Crioprosopus magnificus* Le Conte; (3) *Sternotomis mirabilis* Drury; (4) *Calosoma bonariense* Dej.; (5) *Metallonotus metallicus* Fab.; (6) *Hyperantha haemorrhoa* Fairm.; (7) *Psiloptera bicarinata* Thunbg.; (8) *Stigmodera variabilis* Don.; (9) *Calosoma scrutator* Fab.; (10) *Tragidion fulvipenne* Say; (11) *Odontopezus cupreus* Fab. See text under the following Family headings: Long-horned Beetle, Darkling Beetle, and Ground-beetle. Some of the long-horned beetles spend three years in their grub stage and always pupate with their heads toward the exit from their tunnels.



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1¼ times Natural Size

SOME OF NATURE'S LITTLE JOKES ATTENDED BY A RESPLENDENT COURT

(1) *Sternotomis bifasciata* Fab.; (2) *Buprestis rufipes* Oliv.; (3) *Buprestis aurulenta* Linn.; (4) *Dendrobias reducta* Casey; (5) *Cyllene decora* Oliv.; (6) *Phyllophaga torta* Lec.; (7) *Desmocerus palliatus* Forst.; (8) *Chalcolepidius lacordairei* Cand.; (9) *Mormolyce hagenbachi* Westw.; (10) *Alaus lusciosus* Hope; (11) *Semiotus imperialis* Guer.; (12) *Campsosternus gemma* Cand.; (13) *Chalcolepidius rubripennis* Lec.; (14) *Chrysochroa fulgidissima* Schoenh. See text under the following Family headings: Long-horned Beetle, Metallic Wood-borer, Scavenger Beetle and Leaf Chafer, Ground-beetle, and Click Beetle.

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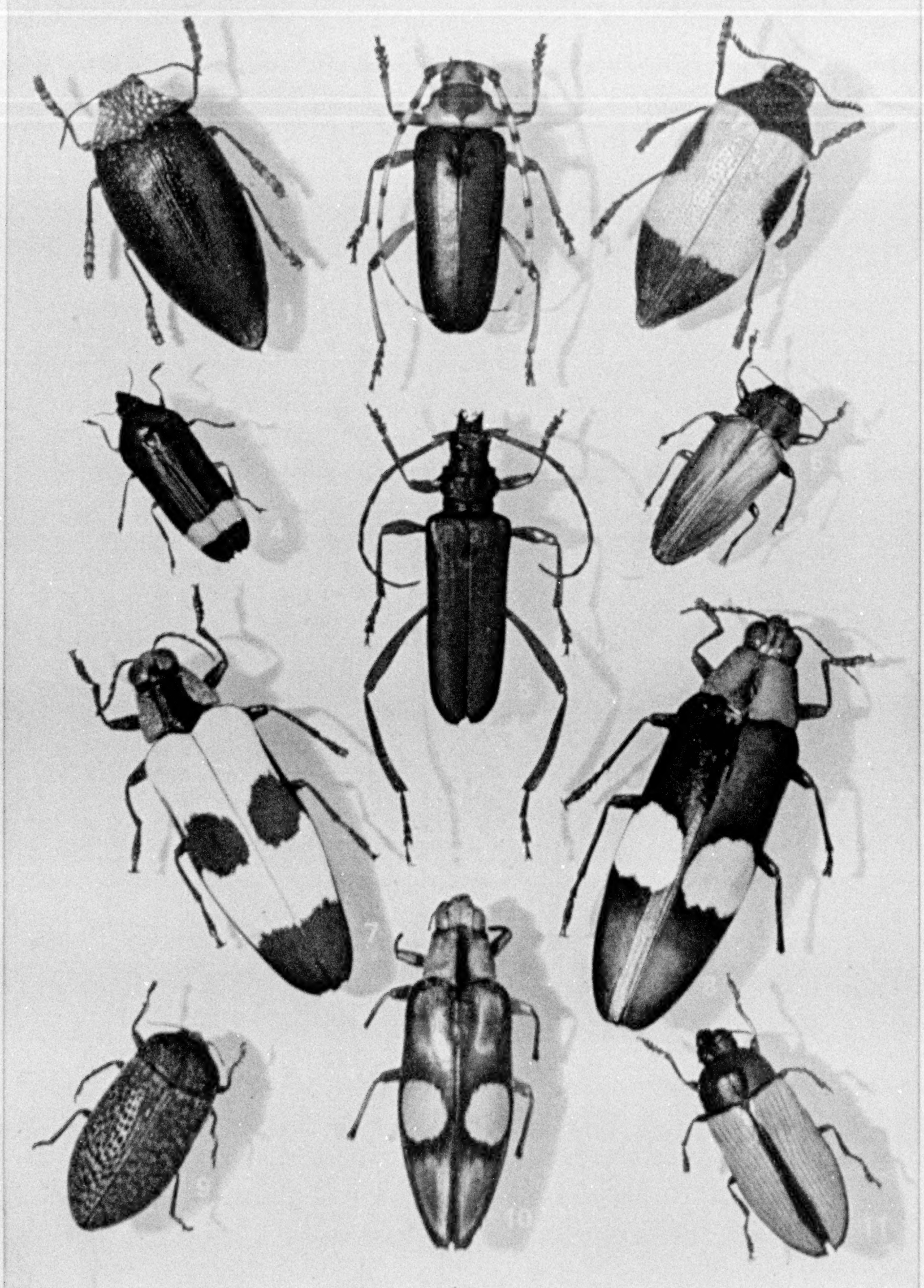

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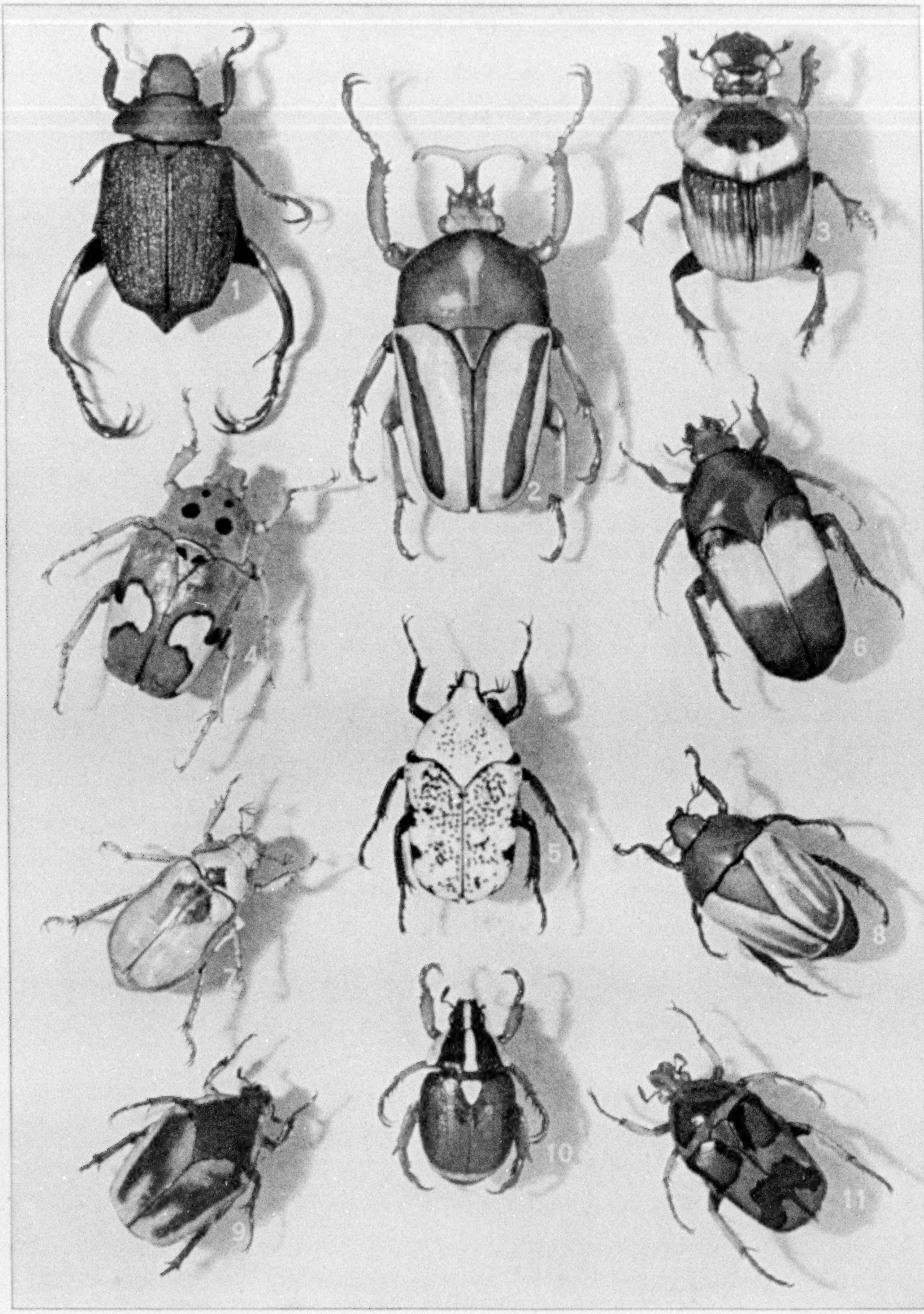
1¼ times Natural Size

FROM WHAT GOLCONDA DO THE BEETLES GET THEIR GEMLIKE GARMENTS?

(1) *Sternocera bennigseni* Kerrem [Male]; (2) *Stenaspis verticalis* Serv. [Female]; (3) *Sternocera hunteri* Waterh. [Male]; (4) *Conognatha amoena* Kirby [Female]; (5) *Callichroma schwarzi* Fisher [Female]; (6) *Belionota sumptuosa* Cast. & Gory [Male]; (7) *Chrysochroa buqueti* Gory [Female]; (8) *Chrysochroa edwardsi* Hope [Male]; (9) *Stigmodera macularia* Donovan [Male]; (10) *Chrysochroa ocellata* Fabricius [Female]; (11) *Stigmodera suturalis* Donovan [Female]. See text under the following Family headings: Metallic Wood-borer and Long-horned Beetle.



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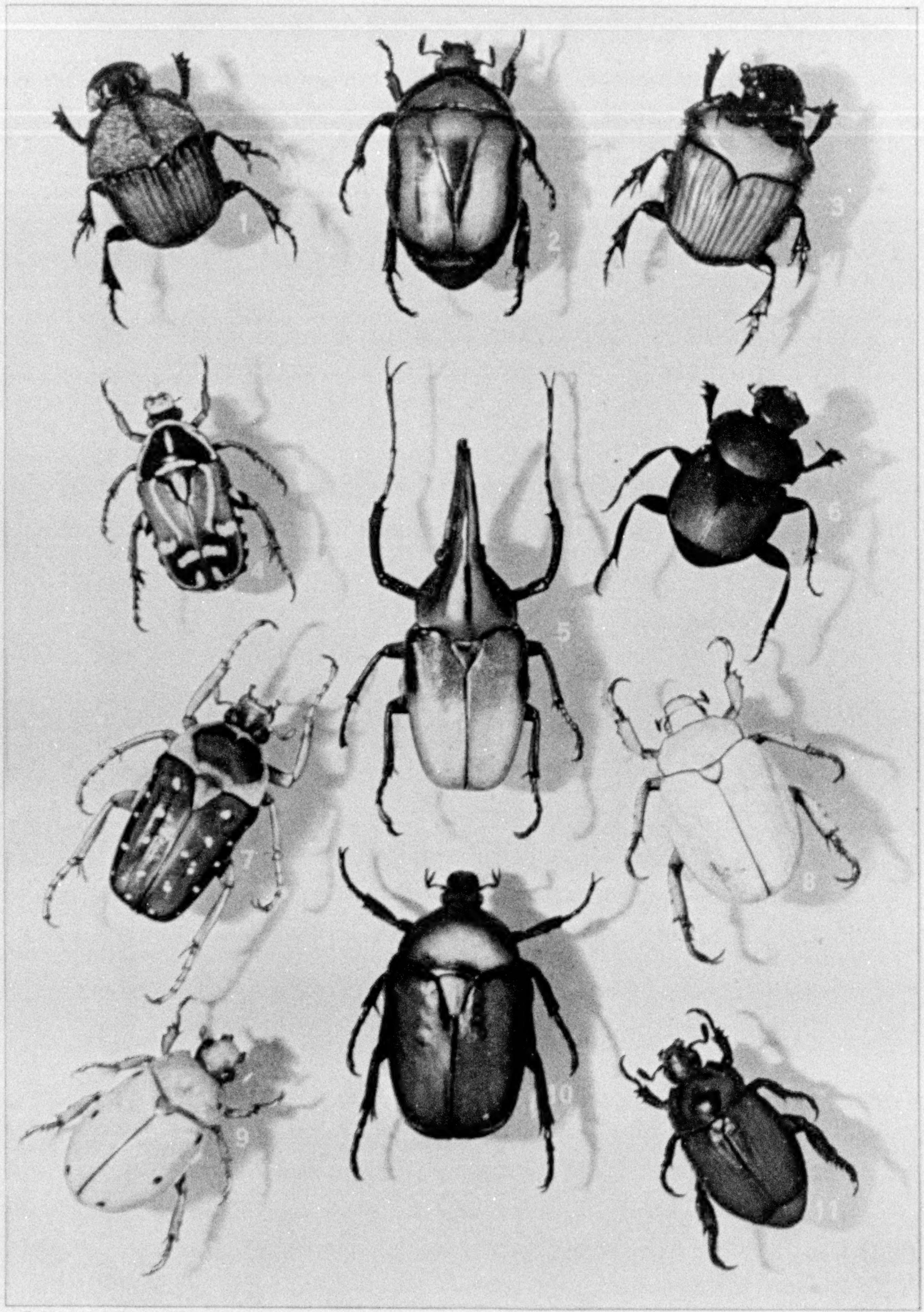
1¼ times Natural Size

DUNG BEETLES IN HABIT, BUT IN ARMOR ROYALLY CLAD

(1) *Chrysophora chrysochlora* Latr. [Male]; (2) *Eudicella morgani* White [Male]; (3) *Phanaeus imperator* Chevr.; (4) *Genyodonta flavomaculata* Fab.; (5) *Argyripa lansbergei* Salle; (6) *Ischiopsopha jamesi* Waterh.; (7) *Plusiotis resplendens* Bouc.; (8) *Macraspis pantochloris* Blanch.; (9) June Bug, *Cotinus nitida* Linn.; (10) *Rutela laeta* Weber; (11) *Heterorrhina macleayi* Kirby. See text under the following Family heading: Scavenger Beetle and Leaf Chafer.



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1¼ times Natural Size

SCARABS THAT MIGHT HAVE MADE A PHARAOH ENVIOUS

(1) *Phanaeus vindex* MacLeay; (2) *Macraspis lucida* Olivier; (3) *Oxysternon festivum* Linn.; (4) *Eupoecila australasiae* Donovan; (5) *Theodosia westwoodi* J. Thoms.; (6) Tumble Bug, *Canthon chalcites* Hald.; (7) *Stephanorrhina guttata* Olivier; (8) Goldsmith Beetle, *Cotalpa lanigera* Linn.; (9) *Pelidnota punctata* Linn.; (10) *Potosia speciosa* Adams; (11) *Pelidnota sumptuosa* Vigors. See text under the following Family heading: Scavenger Beetle and Leaf Chafer.

The round-headed apple-tree borer is perhaps the worst pest among the Cerambycids. In its adult form, it is about three-fourths of an inch long, with two creamy stripes along its brown back from mouth to tail. It deposits its eggs on the bark at the base of the tree it exploits in June and July. These hatch in a few days and the tiny grub works its way into the soft sapwood under the bark.

After its fine chisellike mandibles get the temper of age, it begins to tunnel its way into the heart of the tree, swallowing the borings of the tunnel as it goes. Finally, after three years of eating a path through the wood, it directs its operations toward the surface.

Just before reaching the outer air, and leaving only a tiny membrane ahead of it to be ruptured when it wakes up from its transformation sleep, the grub excavates a nice little chamber, which it carefully lines with smooth, soft materials made from wood fiber, and then lies down for its change-working nap. After two or three weeks of unconsciousness, it awakens no longer a grub, but a fully accoutered long-horn.

The oak pruner has a different method of attack. It lays its egg on a tender twig. When the grub hatches, it enters the twig and feeds on its juicy fiber. As it grows, it relishes a harder diet, so it bores its way into a mature limb, which it finally cuts so thoroughly that when a high wind comes it is blown to the ground. The limb thus acts as a parachute for the grub, allowing it to reach the ground safely. It now uses the severed limb both as a food supply and a habitation. The oak pruner also attacks other trees.

Some species of Cerambycid larvæ remain in wood for surprising periods. After timber is cut and dried and used in the building of houses or the manufacture of furniture, it lacks nutritive qualities, and the growth of the wood-boring grub is so arrested that it often requires many years for the attainment of maturity. I have seen them issue from a porch column that had been standing twenty years, and recently a western college professor reported the issuance of one from the wood of a bookcase that had been in his family for nearly fifty years.

The species reproduced are: *Saperda candida* Fab. (Plate XVIII, figure 7), found in North America; *Sternotomis virescens* Westw. (Plate XX, figure 1), an African species; *Crioprosopus magnificus* LeConte. (Plate XX, figure 2), from Arizona; *Sternotomis mirabilis* Drury. (Plate XX, figure 3), found in the African Gold Coast; *Tragidion fulvipenne* Say. (Plate XX, figure 10), found in central and western United States; *Sternotomis bifasciata* Fab. (Plate XXI, figure 1), found in West Africa; *Dendrobias reducta* Casey. (Plate XXI, figure 4), habitat southern California; *Cyllene decora* Oliv. (Plate XXI, figure 5), habitat southeastern and central United States; *Desmocerus palliatus* Forst. (Plate XXI, figure 7), a native of eastern United States; *Stenaspis verticalis* Serv. (Plate XXII, figure 2), found in Texas, Arizona, and Mexico; *Callichroma schwarzi* Fisher. (Plate XXII, figure 5), found in Texas.

Tiger-beetle Family (*Cicindelidae*). The tiger-beetles are fast runners and quick flyers, and in the larval stage live up to their name, being carnivorous and voracious eaters. In that stage they are uncouth grubs, with big heads and sturdy jaws. They usually dig burrows in the ground, and lie in wait at the entrance for some unfortunate insect that chances to pass that way. In catching their prey the tiger-beetles' larvæ seize the victims with their long, sharp mandibles, and drag them to the bottom of the burrow, where they are eaten at leisure.

The larva is provided with a little hump on the fifth segment of the abdomen, on which are two strong, forward-curving hooks. These it uses to hold itself firmly in position while attacking a victim, lest the latter give a sudden jerk and pull the "bushwhacker" from its hole.

The adult beetles catch their victims and drink the blood after the fashion of a weasel. With their big eyes, long legs, sharp mandibles, and fleet movements, the tiger-beetles are identified easily.

The species reproduced is: *Cicindela scutellaris* Say. (Plate XVIII, figure 8). It ranges between Texas, Arkansas, Nebraska, and Wyoming.

Lady-bird Beetle Family (*Coccinellidae*). Perhaps no beetle clan surpasses the lady-birds as friends of man. Their pretty polka-dot wing cases and their gentle demeanor are in keeping with their beneficent relation to man. But to certain of our insect foes the larvæ of this family are veritable roaring lions and stalking tigers going about seeking whom they may devour. Plant-lice, scale insects, and many others of the "wee beasties" of insectdom the lady-birds destroy by the billions.

The larvæ are more active than beetle grubs usually are, running about on plants in search of game. They ordinarily "change their clothes" three times before reaching maturity, sometimes changing their color in doing so. They spend four or five weeks in the larval stage; the eggs are laid on the bark, stems, and leaves of the trees or plants they visit, and hatch in a few days.

There are about 2,000 known species of lady-birds in the world, of which about 150 species are natives of America. Some have the curious habit of congregating in great masses on mountain tops, to spend the winter, once they have gotten their wings. California fruit growers collect them, and put them in cold storage where they are retained until they are needed for keeping down plant-lice the following summer (see illustration, page 9).

The species reproduced is: *Epilachna borealis* Fab. (Plate XVIII, figure 10), which ranges over North America and Mexico.

Scavenger Beetle and Leaf Chafer Family (*Scarabaeidae*). The Scarabaeid family has two branches, well differentiated by their habits—the scavengers, of which the tumble bug or dung beetle is typical; and the leaf chafers, of which the rose bug or rose chafer is a representative species.

There are about 13,000 known species of Scarabaeids, of which about 5,000 belong to the dung beetle branch of the family.

The ancient Egyptians, observing the beetle's habit of rolling around pills of dung and dirt, are supposed to have interpreted this practice as a typification of the planetary and lunar revolutions, and therefore held that its disappearance and return was emblematic of eternal life (see, also, illustration, page 44).

The leaf chafers constitute the more numerous branch of the Scarabaeid family. In size, the species range from the big June bug or May beetle, down to the small rose chafer or rose bug. The larvæ of the iridescent May beetle are big fat grubs found in lawns, fields, and gardens. They spend three years in their journey from the egg to the possession of wings. In the fall they dig below the frost line, and in the spring come up again to spend the summer feeding on the tiny roots of vegetation.

The rose chafer larvæ seem to thrive best in sandy ground. Observers have noted that in regions where there is a strip of land underlaid with a clay subsoil, bordered by another strip in which there is a sandy subsoil, very few rose chafers appear until the wind blows from the sandy subsoil region. They then come in hosts to the land underlaid with clay.

A newly imported member of the Scarabaeid family is the destructive green Japanese beetle, which a few years ago gained a foothold above Philadelphia on the Jersey side of the Delaware River.

The species reproduced are: *Macrodactylus angustatus* Beauv. (Plate XVIII, figure 11), found in North America; *Popillia japonica* Newman. (Plate XVIII, figure 13), introduced into the United States from Japan; *Phyllophaga torta* Lec. (Plate XXI, figure 6), found in North America; *Chrysophora chrysochlora* Latr. (Plate XXIII, figure 1), found in Ecuador and Peru; *Eudicella morgani* White. (Plate XXIII, figure 2), native of West Africa; *Phanaeus imperator* Chevr. (Plate XXIII, figure 3), habitat South America; *Genyodonta flavomaculata* Fab. (Plate XXIII, figure 4), found in Africa; *Argyripa lansbergei* Salle. (Plate XXIII, figure 5), habitat Brazil; *Ischiopsopha jamesi* Waterh. (Plate XXIII, figure 6), a species from British New Guinea; *Plusiotis resplendens* Bouc. (Plate XXIII, figure 7), a native of Costa Rica; *Macraspis pantochloris* Blanch. (Plate XXIII, figure 8), found in South America; June Bug (*Cotinus nitida* Linn. Plate XXIII, figure 9), a native of eastern and southern United States; *Rutela laeta* Weber. (Plate XXIII, figure 10), found in northern South America; *Heterorrhina macleayi* Kirby. (Plate XXIII, figure 11), a native of Central America; *Phanaeus vindex* MacLeay. (Plate XXIV, figure 1), found in eastern United States; *Macraspis lucida* Olivier. (Plate XXIV, figure 2), found in Central and South America; *Oxysternon festivum* Linn. (Plate XXIV, figure 3), South American species; *Eupoecila australasiae* Donovan. (Plate XXIV, figure 4), native of Australia; *Theodosia westwoodi* J. Thoms. (Plate XXIV, figure 5), habitat Borneo; Tumble Bug (*Canthon chalcites* Hald. Plate XXIV, figure 6), a native of North America; *Stephanorrhina guttata* Olivier. (Plate XXIV, figure 7), found in West Africa; Goldsmith Beetle (*Cotalpa lanigera* Linn. Plate XXIV, figure 8), found in eastern United States; *Pelidnota punctata* Linn. (Plate XXIV, figure 9), familiar species in eastern United States; *Potosia speciosa* Adams. (Plate XXIV, figure 10), habitat southwestern Asia; *Pelidnota sumptuosa* Vigors. (Plate XXIV, figure 11), found in South America.

Snout Beetle Family (*Otiorhynchidae*). This family is represented in our fauna by more than 200 species. It includes Fuller's rose beetle, the strawberry crown girdler, and the black vine weevil. Many of its members are notorious as greenhouse pests.

The species reproduced are: *Cyphus 16-punctata* Linn. (Plate XVIII, figure 12), found in South America; *Hypomeces squamosus* Fab. (Plate XVIII, figure 14), found in India.

Erotylidae Family. This is a small family which resembles click beetles in form, and whose larvæ bore into the stalks of clover. The larvæ of some species feed on fungi.

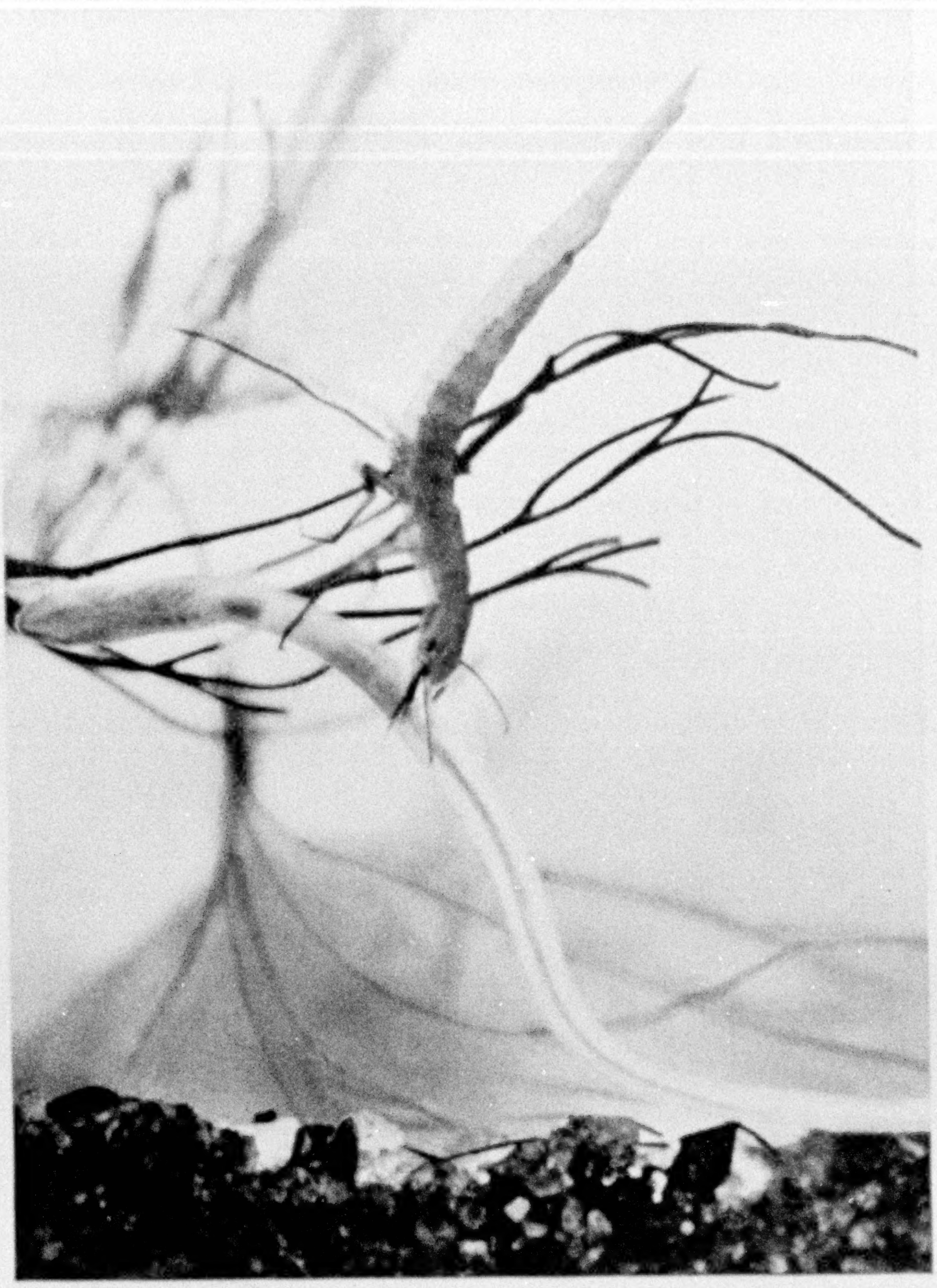
The species reproduced is: *Erotylus giganteus* Linn. (Plate XIX, figure 3), which occurs in Cayenne, French Guiana.

Carabid Beetle Family (*Carabidae*). The 1,200 species of this group of beetles contain many interesting insects. One of these is the bombardier beetle which, when pursued or attacked by an enemy, fires at the foe a tiny puff of acrid, reddish "smoke," with a popgun report. Comstock has found that the bombardier is able to use four or five rounds of ammunition without exhausting its supply.

One species belonging to the Carabid family is known as *Calosoma scrutator*, the latter part of its name being derived from its habit of scrutinizing everything in its search for caterpillars. It and its close cousins are popularly known as caterpillar hunters. One species has been brought to America from Europe to help wage war on the brown-tail moth. Some of the Calosomas are aggressive foes of the hairy tent-caterpillar that is such an enemy of the orchardist and landscape gardener.

Other Carabids eat the larvæ of codling moths and of the plum curculio. Some species here and elsewhere dwell in caves, and are sightless. Other species dwell in moist, damp places where snails may be found, and have their palpi shaped like long-handled spoons suitable for drawing snails out of their shells.

The species illustrated are: *Carabus auronitens* Fab. (Plate XIX, figure 4), a native of Central Europe; *Ceroglossus gloriosus* Gerst. (Plate XIX, figure 6), found in Chile; *Calosoma bonariense* Dej. (Plate XX, figure 4), found in Brazil and Argentina; *Calosoma scrutator* Fab. (Plate XX, figure 9), a North American species; *Mormolyce hagenbachi* Westw. (Plate XXI, figure 9), a native of Sumatra.



Photograph by Paul Griswold Howes

A LARVAL WATER-TIGER FEEDING ON A YOUNG EEL

The insect fastened its jaws in the flesh of the eel and swam with great effort to a higher perch in the aquarium. Here it sucked the body juices of the victim until it became white. The water-tigers are among the most ferocious of all the insects.

Predaceous Diving Beetle Family (*Dytiscidae*). There are some 300 species of this family of predaceous carnivorous diving beetles in America. They get their name of water-tigers from the persistent manner in which their larvæ search for living food. Research indicates that the adults hibernate in mud, under water. It is believed that the water-tigers were once dry-land dwellers.

Nagel states that the water-tigers secrete a digestive fluid which they inject into the body of their victims, turning the latter's flesh to broth. On this they sup at their pleasure. The mature beetles live for a long time, one entomologist having kept a *Dytiscus* three and a half years in perfect health in a glass vessel filled with water. He fed it bits of raw meat.

The species reproduced are: *Dytiscus fasciventris* Say. (Plate XIX, figure 9), and *Cybister fimbriolatus* Say. (Plate XIX, figure 11), both found in North America.

Darkling Beetle Family (*Tenebrionidae*). These insects occur chiefly in dry and warm regions. Most of the American species, of which there are more than 400, occur in the southern section of the United States. The family includes the *Tenebrio* meal-worm, the forked fungus beetle, and the pinacate bugs. The latter defend themselves when disturbed by elevating the hind part of the body and discharging an oily fluid. After being attacked they walk off clumsily, presenting an absurd appearance with the end of the body held as high as possible.

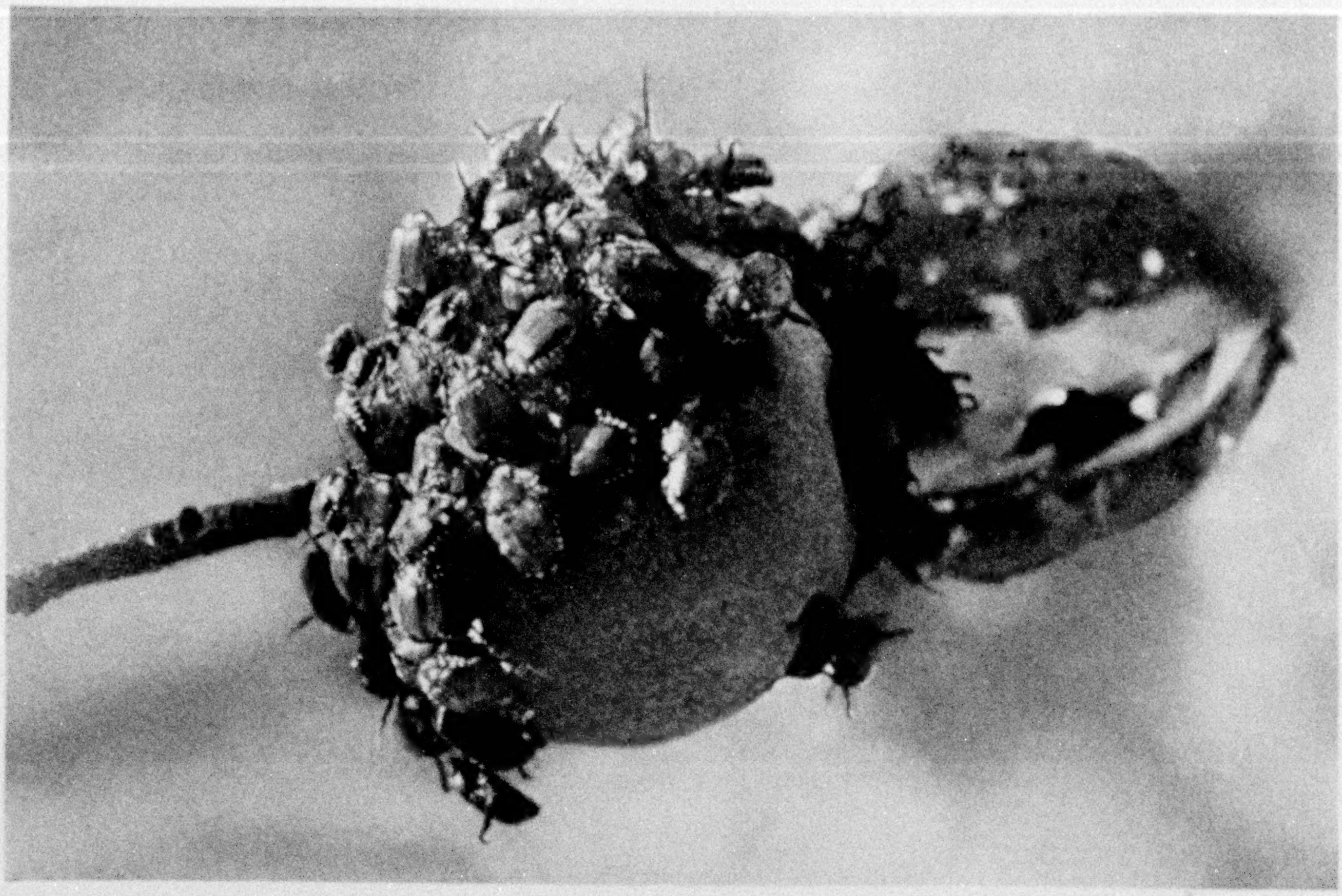
The species reproduced are: *Metallonotus metallicus* Fab. (Plate XX, figure 5), and *Odontopezus cupreus* Fab. (Plate XX, figure 11), found in Africa.

Click Beetle Family (*Elateridae*). The click beetles form a most interesting and cosmopolitan family. There are about 7,000 known species, of which some 350 are found in North America.

The larvæ of the click beetles are the familiar wire-worms which often do so much damage to crops just beginning to grow. Corn, meadow grass, wheat, and other cereals suffer severely from the periodic invasion of the wire-worms. The beetles fly about the fields in the late spring, depositing their eggs in plowed or grassy ground.

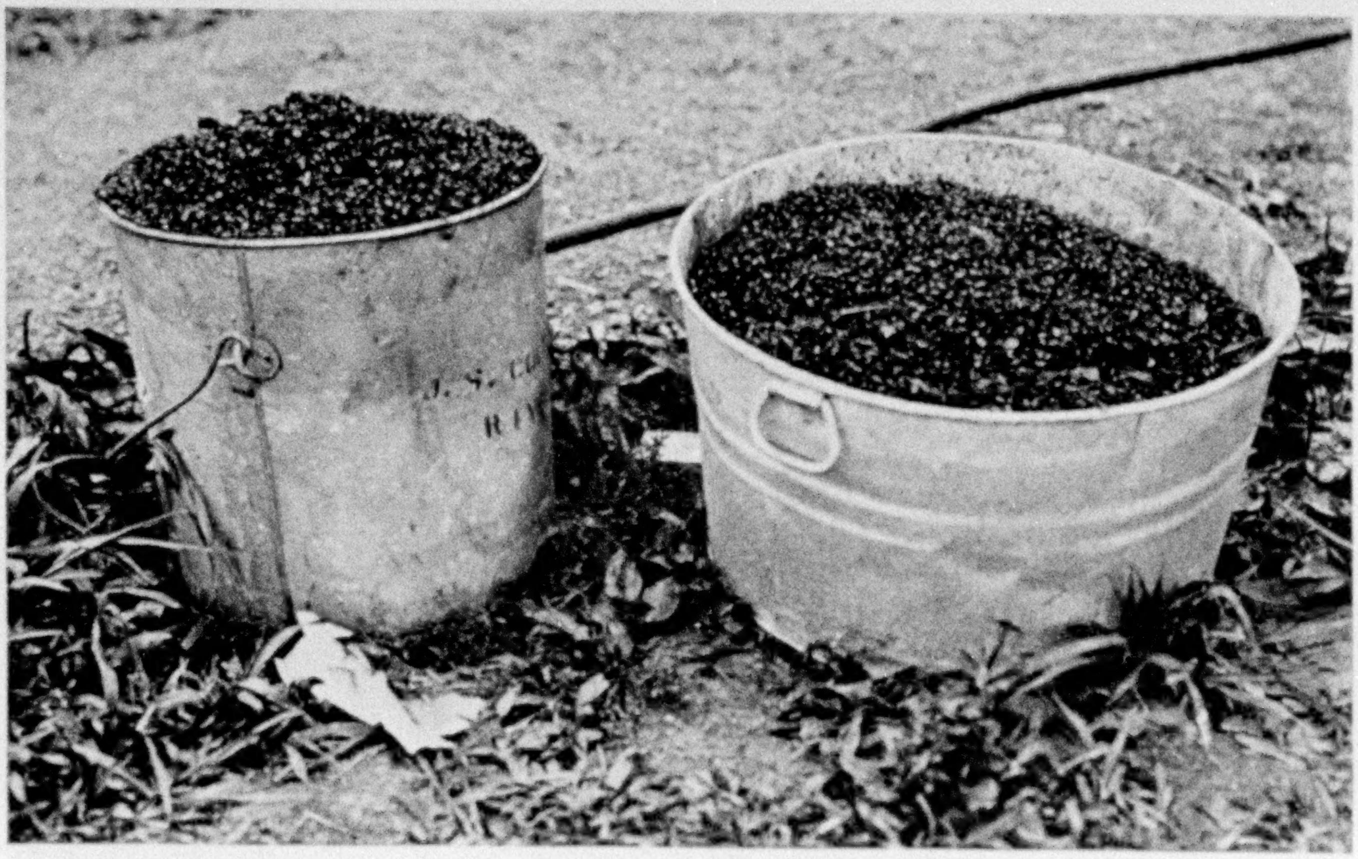
In Cuba there are phosphorescent species which emit a strong greenish light. Many women keep them alive in little lace pockets, or fastened to delicate golden chains.

The species reproduced are: *Chalcolepidius lacordairei* Cand. (Plate XXI, figure 8), found in Mexico and Nicaragua; *Alaus lusciosus* Hope. (Plate XXI, figure 10), found in Mexico and southwestern United States; *Semiotus imperialis* Guer. (Plate XXI, figure 11), a native of South America, especially Colombia, Venezuela, and Peru; *Campsosternus gemma* Cand. (Plate XXI, figure 12), a native of China; *Chalcolepidius rubripennis* Lec. (Plate XXI, figure 13), a native of Lower California and Honduras.



JAPANESE BEETLES DINE ON A PEACH

At the beginning of the season the beetles attack the fruits prematurely ripening because of infestation by other foes, but later they turn their attention to the sound peaches, apples, etc. As many as 278 beetles have been removed from a single fruit.



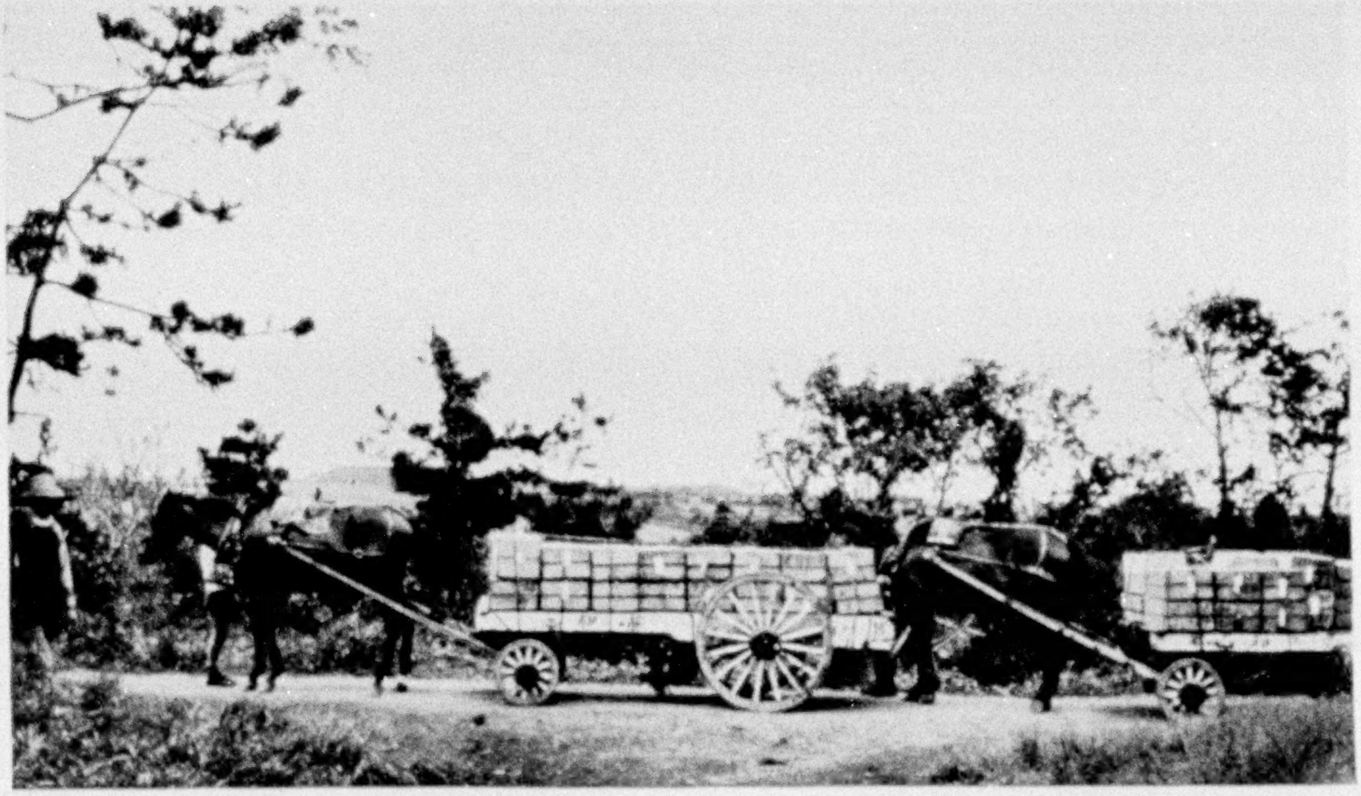
Photographs courtesy U. S. Department of Agriculture

JAPANESE BEETLES COLLECTED BY BOYS AT RIVERTON, NEW JERSEY

In 1916 only a few beetles could be collected by one person in a single day. By 1919 they had become so thick that one person could collect as many as 20,000 in 12 hours. During a recent season an average of one and one-third gallons of beetles were shaken from each of 156 ten-year-old peach trees, all of which seemed as full as ever 24 hours later. An average of 175 larvæ were found in each square yard of a New Jersey pasture.

COLLECTORS OF PARASITIZED JAPANESE BEETLES AT SAPPORO, JAPAN

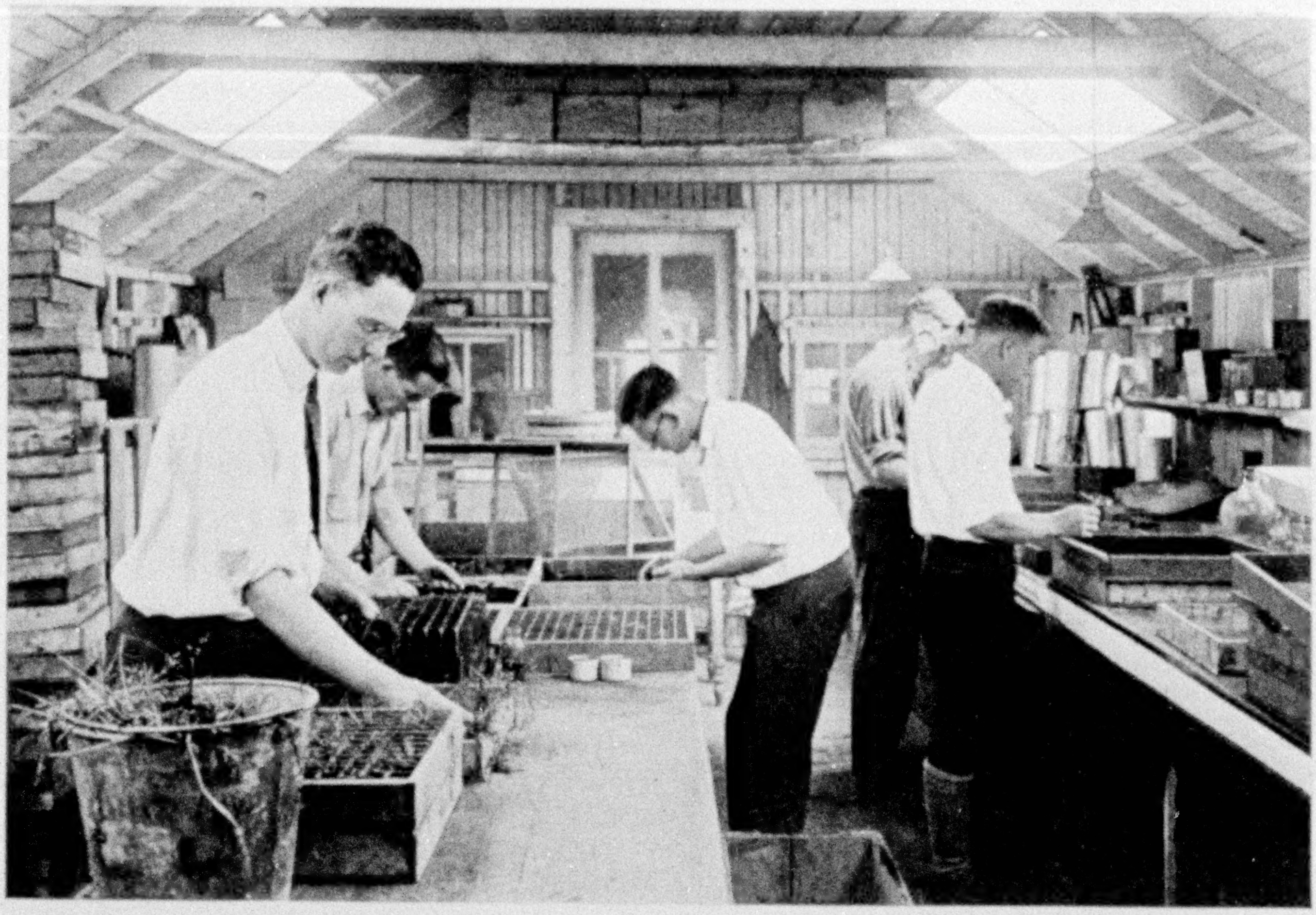
Scores of women and children of Japan have been enlisted in the work of gathering proved parasites of the Japanese beetle to send to the United States and help us destroy the beetle by this means.



Photographs courtesy U. S. Department of Agriculture

ARMIES OF ALLIES BEING SHIPPED FROM KOIWAI, JAPAN, TO RIVERTON, NEW JERSEY

Nearly 8,000 parasitized grubs of the Japanese beetle are contained in the boxes of this shipment. The parasites belong to the Scoliid wasp family. While man probably will continue to resort to mechanical warfare in holding the Japanese beetle in check, the major offensive is being conducted by insect allies imported from Japan, including three species of the Tachina fly family (see text, page 67), two species of the Dexiid fly family (see text, page 70), four species of the Scoliid wasp family (see text, page 52), and one species of the Carabid beetle family (see text, page 86).



Photograph courtesy U. S. Department of Agriculture

PREPARING TO RAISE AN ARMY OF ALLIES TO FIGHT JAPANESE BEETLES

These workers in the Moorestown, New Jersey, laboratory of the United States Bureau of Entomology are unpacking material just received from Japan. The shipment contains eggs of a little Tachina fly (see text, page 52) which preys on Japanese beetles in the land of the Mikado. It is hoped that the flies from these eggs will slaughter millions of beetles.

The natural-color illustrations of 263 insects in this number of the NATIONAL GEOGRAPHIC MAGAZINE are the result of more than three years of research, selection, and experimentation by the illustrations division of The Magazine.

The specimens pictured represent most of the insect families to be found in North America. They were selected from the U. S. National Museum's collection of more than a million individuals through the generous coöperation of the experts of the Museum and of the Bureau of Entomology of the U. S. Department of Agriculture.

Each specimen reproduced on the 24 full-page color plates was chosen as the most picturesque and colorful representative of its species or family. The subjects selected were placed with care in relaxing jars (a sort of humidor) to render flexible their delicate legs, wings, and antennæ, so that they might be "posed" in lifelike attitudes. After the humidor treatment, the individuals were grouped according to their scientific relation one to another, and each group was then skillfully arranged for symmetry and with appreciation of color contrasts.

The minuteness of some of the specimens, their irreplaceable value in the Museum's collection, and the fragile nature of their many anatomical members added materially to the sense of responsibility of the members of the National Geographic Society's illustrations staff and to the time required in obtaining the desired results.

The 21 color plates of specimens, on each of which is reproduced from 6 to 21 individual insects, were arranged and photographed by Mr. Edwin L. Wisherd, of The Society's photographic staff.

Supplementing the photographic records of the actual specimens are the three paintings showing the life history of three representative insect families—the Caddis-fly (Plate I), the Bumble-bee (Plate IX), and the Japanese Beetle (Plate XVII). These have been executed in microscopic detail by The Society's naturalist-artist, Mr. Hashime Murayama.

FRANKLIN L. FISHER.

THE SEALING SAGA OF NEWFOUNDLAND

By Captain Robert A. Bartlett

EIGHT o'clock in the morning, March 7, the port of St. Johns, Newfoundland, is black with men. On that day the sealing fleet sails for the annual hair-seal hunt, the second most valuable fishery of the island. St. Johnsmen line Water Street and crowd out on the piers where the ships lie (see illustration, page 96).

A ROYAL SEND-OFF FOR THE FLEET

Eight ships—four steel, four wooden—two thousand men, the pick of Newfoundland fishermen, steam down the harbor and out past Chain Rock through the notch. The heartfelt wishes of St. Johns and the whole island go with those men and ships.

Whistles scream Godspeed, bells ring out, cannons fire salutes, bunting flies on ship and shore, boys and men race along the Battery Road, cheering the ships to the Narrows and beyond.

Two days previously the vanguard of the fleet, the *Terra Nova*, of Arctic and Antarctic fame and a long sealing record, and the *Thetis*, skippered by William Bartlett, my father, who has been 50 years old for the last quarter of a century—and lives and acts it—sailed from St. Johns for the "back of the island." These two vessels have farther to go, south around Cape Race and west by St. Pierre, to reach the Gulf of St. Lawrence seals, so they go earlier.

Sailing dates are fixed by law and not by weather. No killing is permitted before March 14 nor after May 1.

I have been with the sealing fleet nineteen times and almost as many times on Arctic expeditions with Peary and others. Sealing is a hard life. It is more dangerous than exploring in the Arctic; there's no question about it.

But the excitement of sealing appeals to the right sort of fellow. I have heard men take an oath that they would never, never go again. And they have been the very first ones looking for their berths next spring.

Among the Bartletts seal hunting has been the means of livelihood for more than a century. My great-great-great uncle, Billy Bartlett, was the first man to bring his little shallop beyond the confines of Conception Bay. The story goes—and this is no legend; it is a fact—that with his shallop he went on north to the Funks and found no ice. His crew wondered at him going so far north so early in the year. But he said, "Follow on." And follow on they did. Finally he reached the Labrador coast and found the ice, and on the ice were seals. They soon filled the shallop up and he returned home to Brigus. Forever afterward he was known as "Follow On Bartlett."

So the Bartletts have taken part in the rise of the fishery from the very beginning; from the shallop to the big steel boats. They were following it when it reached its peak in the '50's, when over 400 sailing vessels and 13,000 men prosecuted the seal fishery. Those were the days of big catches; one year the catch reached 700,000 seals. When steam vessels began to displace the sailing fleet, Bartletts were among the first to skipper them.

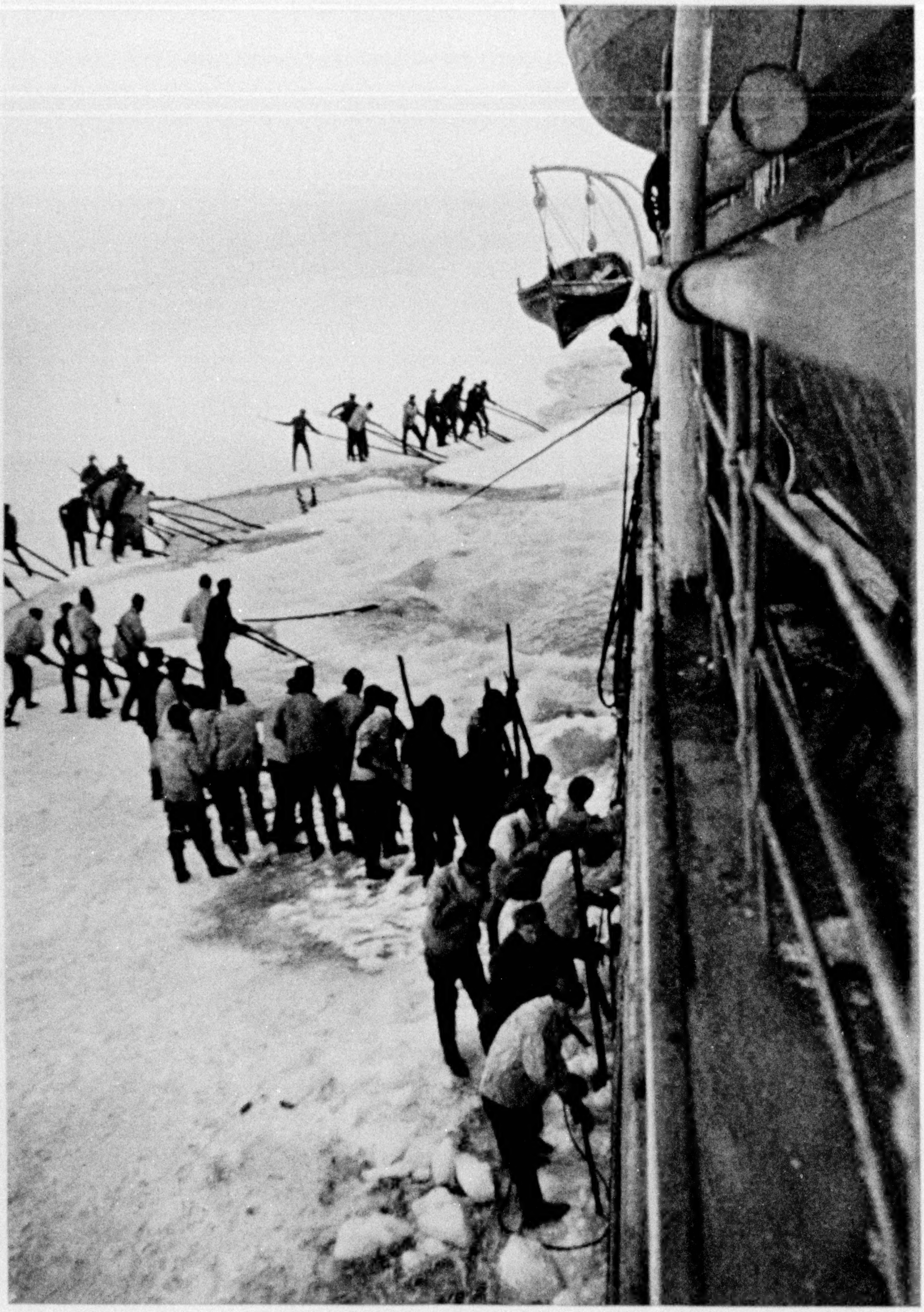
I can just remember the last of the sailing vessels. In my youth, father, Uncle Sam, Uncle Harry, Uncle John, and a cousin, Moses Bartlett, skippered vessels of the sealing fleet. Father is still at it.

Father goes because he likes it. He's just like an old fire horse when it hears the bell. The excitement of it, the lure of it, make him go.

THE START FOR ST. JOHNS

The sealing hands start from the various outports, south and north, late in February, moving on St. Johns, the capital. It is the worst time of the year—rough weather. The men bid good-bye to their families and start out, many on snowshoes, walking to trunk-line railway stations.

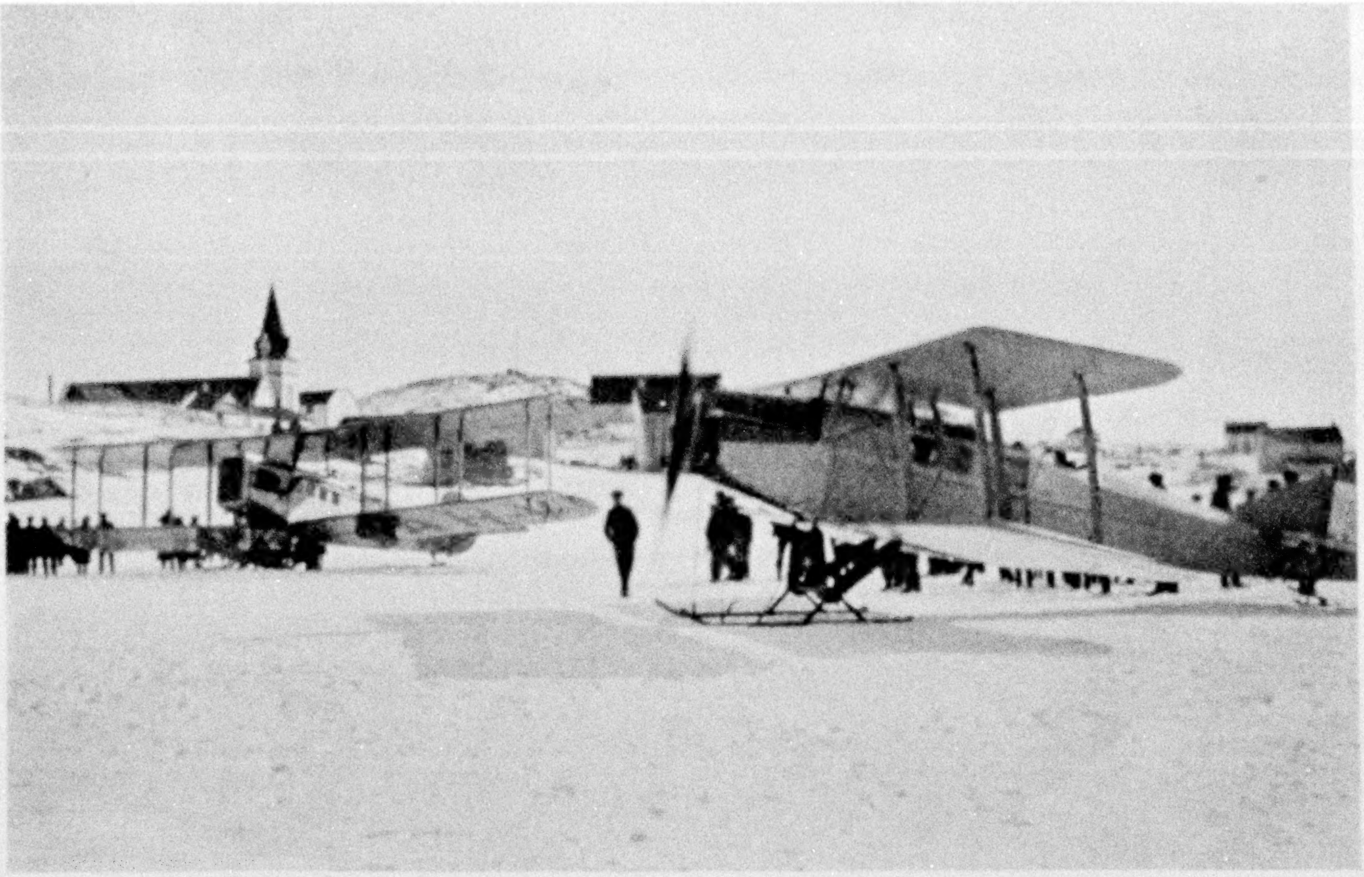
St. Johns begins to fill up with them the first days of March. They wear canvas jumpers over homemade guernseys (sweaters), moleskin or homespun trousers, one to four red or white flannel shirts, and home-knit, heavy drawers. Some wear sealskin caps and some elsinors



Photograph by George Harding

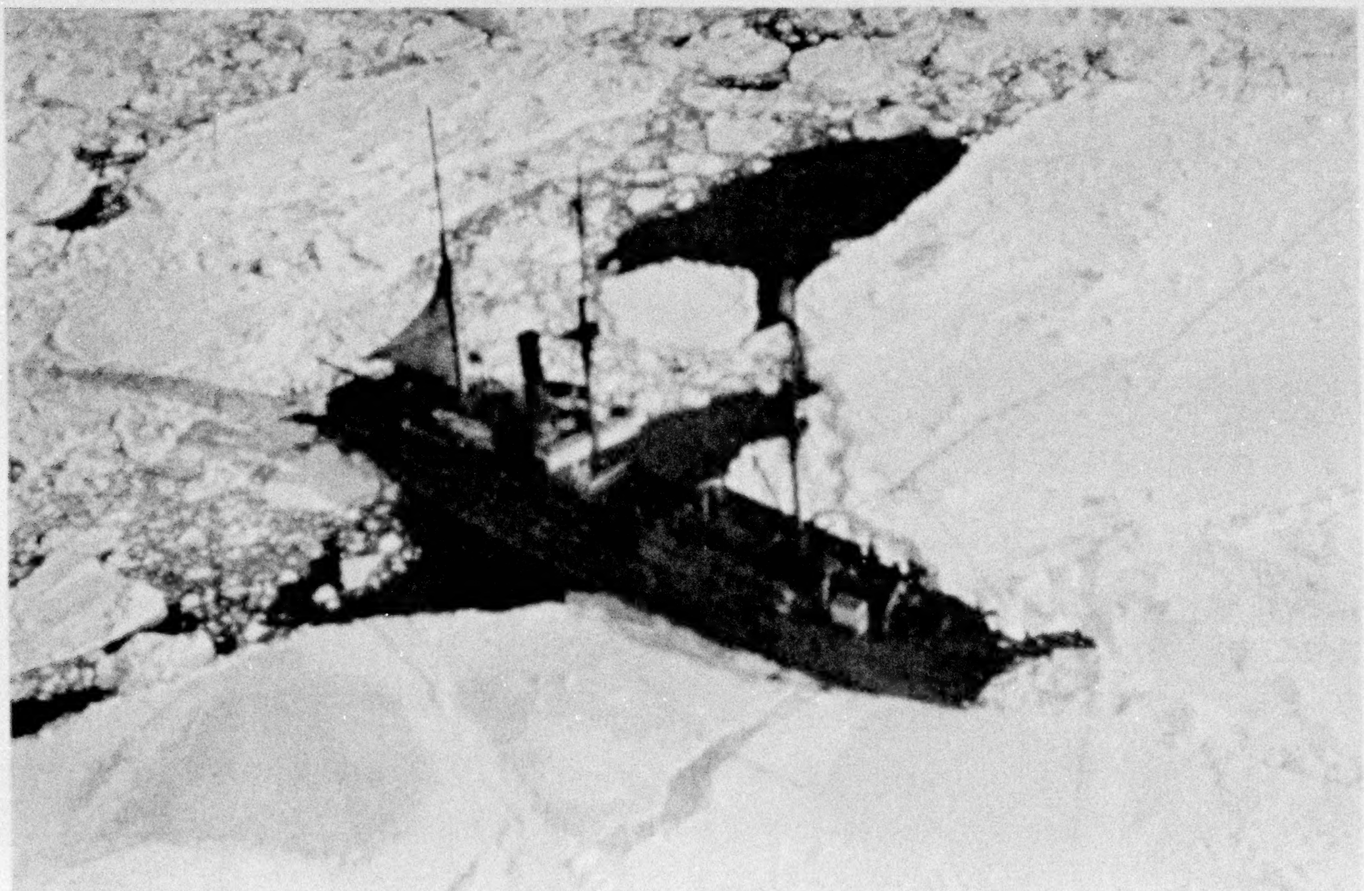
A SEALER MUST BE HALF SEAL HIMSELF

The ice is his element. He lives on it during most of the trip. "Get out and push" is no seagoing joke when the skipper's aim is to keep moving. A vessel jammed in the ice, as is the case here, is as helpless as a seaplane on a desert. It cannot get to the seals. Prospects of crew and captain for a profitable voyage grow dim. Rafting ice may crush in the sides or a storm carry both ice and vessel on shore.



SEAL SCOUTING SHIPS TUNING UP AT FOGO, NEWFOUNDLAND

The whole Newfoundland sealing fleet in other years has, on occasions, hunted as long as a month for the "main patch." Finding seals is a matter of minutes for scouting airplanes.



Photographs © Aërial Survey Co., courtesy George Allan England

THE "TERRA NOVA" HITS THE WHITE LINE

To the airplane pilot scouting for seals the vessels look like toys on a birthday cake. All the skill of Newfoundland skippers cannot always save the ships that drive into the grinding ice floes. Of 57 famous sealing steamers, 29 have been lost. One ever-present peril is loss of a propeller by striking broken ice cakes. Vessels are like nuts, the weakest walls are the sides, and for a ship to be nipped amidships by pressing pans is often fatal.

OFF FOR THE SEAL FISHERY WITH BOX AND BAG

February in Newfoundland finds men of the outports making their way over snow-filled trails to the nearest railroad station (see text, page 93).

Photographs by Capt. Robert A. Bartlett

THE MEN WHO CATCH YOUR POCKETBOOKS

A hardy lot are the Newfoundlanders who sail on the annual seal hunt before winter has lifted its ice blanket. The skins they take become pinseal pocketbooks and novelties. Layers of fat on each skin supply oil for the American soap industry. Recently the crews have been ordered to bring in seal livers, from which the important medical product insulin is extracted.

THE AUTHOR AT THE WHEEL OF HIS VESSEL

Capt. "Bob" Bartlett was born at Brigus, Newfoundland, in 1875. At the age of 15 he left school to go on his first sealing trip with his father in the *Panther*. When he was 19 he had his first sealing command. He was in command of Peary's ship, the *Roosevelt*, in 1908-9, when the great explorer finally reached the North Pole. In 1913-14 he commanded the *Karluk* when it was caught and crushed in the ice 90 miles off Wrangell Island, and led 16 survivors of the disaster safely to land over the ice. He now owns and commands the *Morrissey*, which has been engaged for various Arctic expeditions.

or whalers, which are leather, wool-lined caps with ear flaps. Their mittens are also homemade. Some have tanned sealskin boots soled with leather; others wear three-quarter boots, and others buskins, a low blucher with a wool stocking pulled over.

ONLY THE KEENLY ALERT AND ACTIVE QUALIFY AS HUNTERS

Captains like to sign up men who frequent the open bays fishing and hunting birds and who are seasoned in the woods. A man who has been dragging a sled and lugging wood all winter is in fine fettle for the job ahead of him. He's got good wind to go after the seals. A man snogging seals has to be light-footed, running and jumping over the ice like a deer. A big fellow with broad shoulders has to be followed around with a life belt; he will be falling into the water all the time.

You want men light and nimble, rawboned fellows, small. Sometimes, to get light, we take off everything except our underwear and boots, in order to follow fast after the seals, which can go as fast or faster than a good man running.

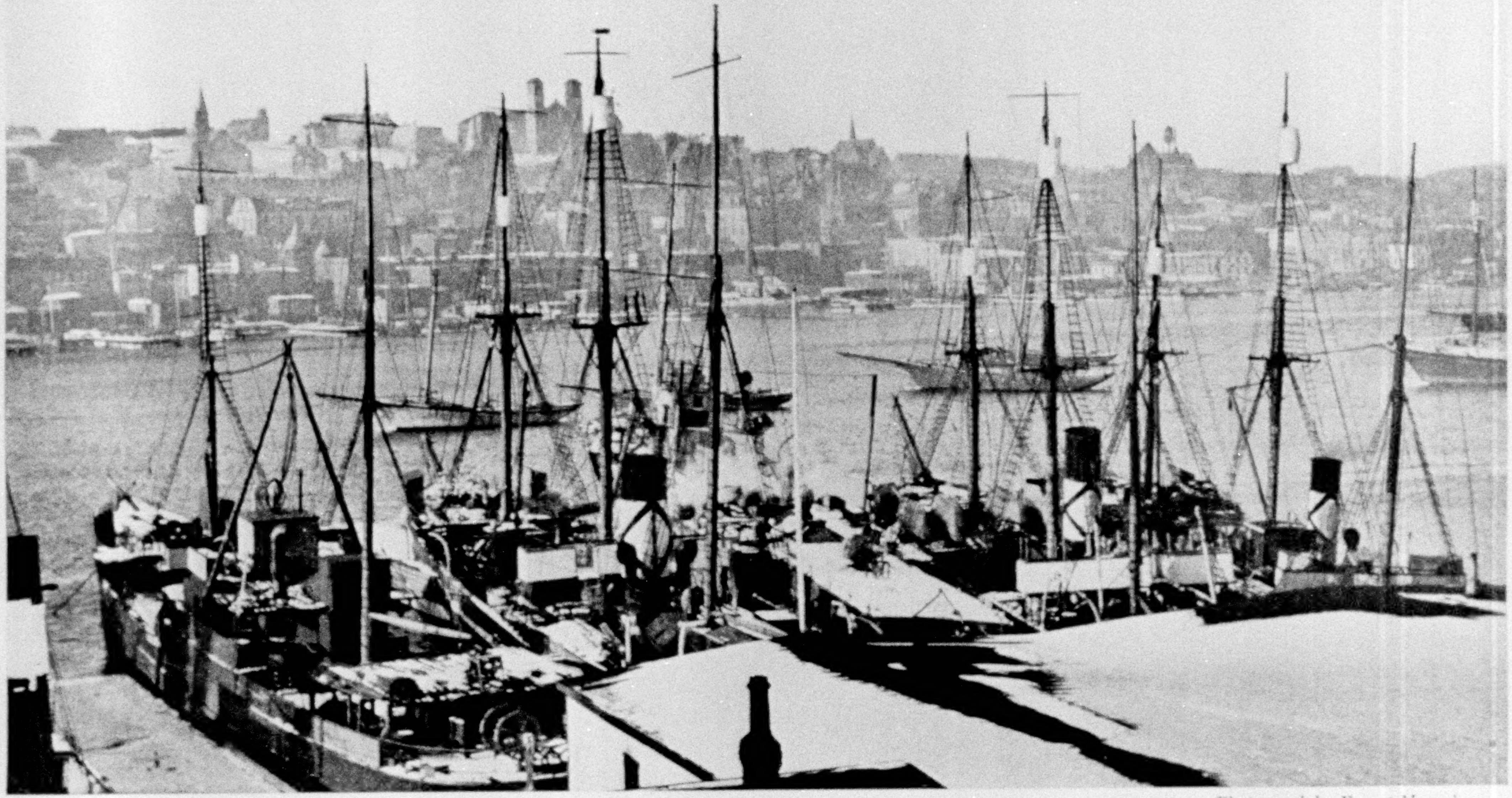
In St. Johns are two concerns that own the vessels and outfit the crews. Between seasons contracts are made with the captains.

A sealing captain is supreme. He can do anything with his ship and his crew, as long as he brings in the seals.

CREWS SIGN ON FOR SHARES

The day is appointed for the signing of the men. "The *Thetis* will sign her crew at 9 o'clock," says a placard on the office of the owners. Men fill up the room and the clerk reads the whereases, the wherefores, the whys, and the shares. Then the sealers put down their names or make their crosses if they can't write.

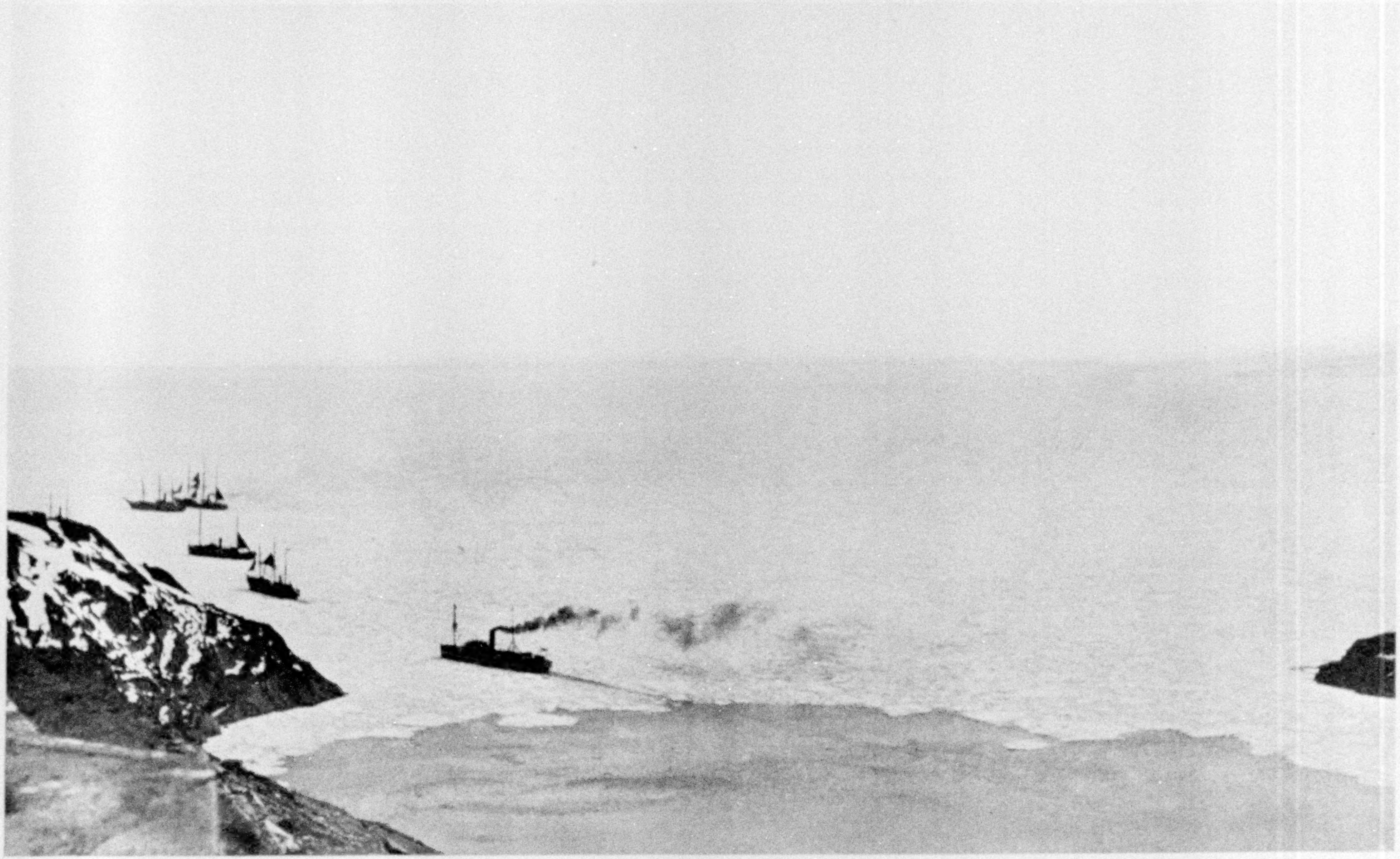
Each sealer then receives a ticket with his number and name on it, and also a "crop." A crop is an advance of $9; but



Photograph by Ernest Maunder

PART OF THE SEALING FLEET IN ST. JOHNS HARBOR AWAITING SAILING DAY

Eight vessels steam out of the harbor on the morning of March 7, amid cheers of citizens crowding the wharves: the *Imogene* and the *Nascopie*, two 2,000-ton steel vessels, each with 280 men hanging over the rails waving caps and shouting good-byes; the *Ranger*, grandmother of the fleet, a wooden sealer sailing on her 57th seal hunt; the *Neptune*, queen of the sealers—she has brought in a million and a half pelts in 56 years; the *Viking*, another old warrior of the ice pans; the *Eagle*, formerly a Norwegian tramp; and the *Beothic* and *Ungava*, two American lakers strengthened to meet the ice. The *Sagona* and *Florencia* this year, for the first time, sailed from Port Union, Newfoundland. The latter vessel, which is new in the seal fishery, was crushed by growlers in the Strait of Belle Isle.

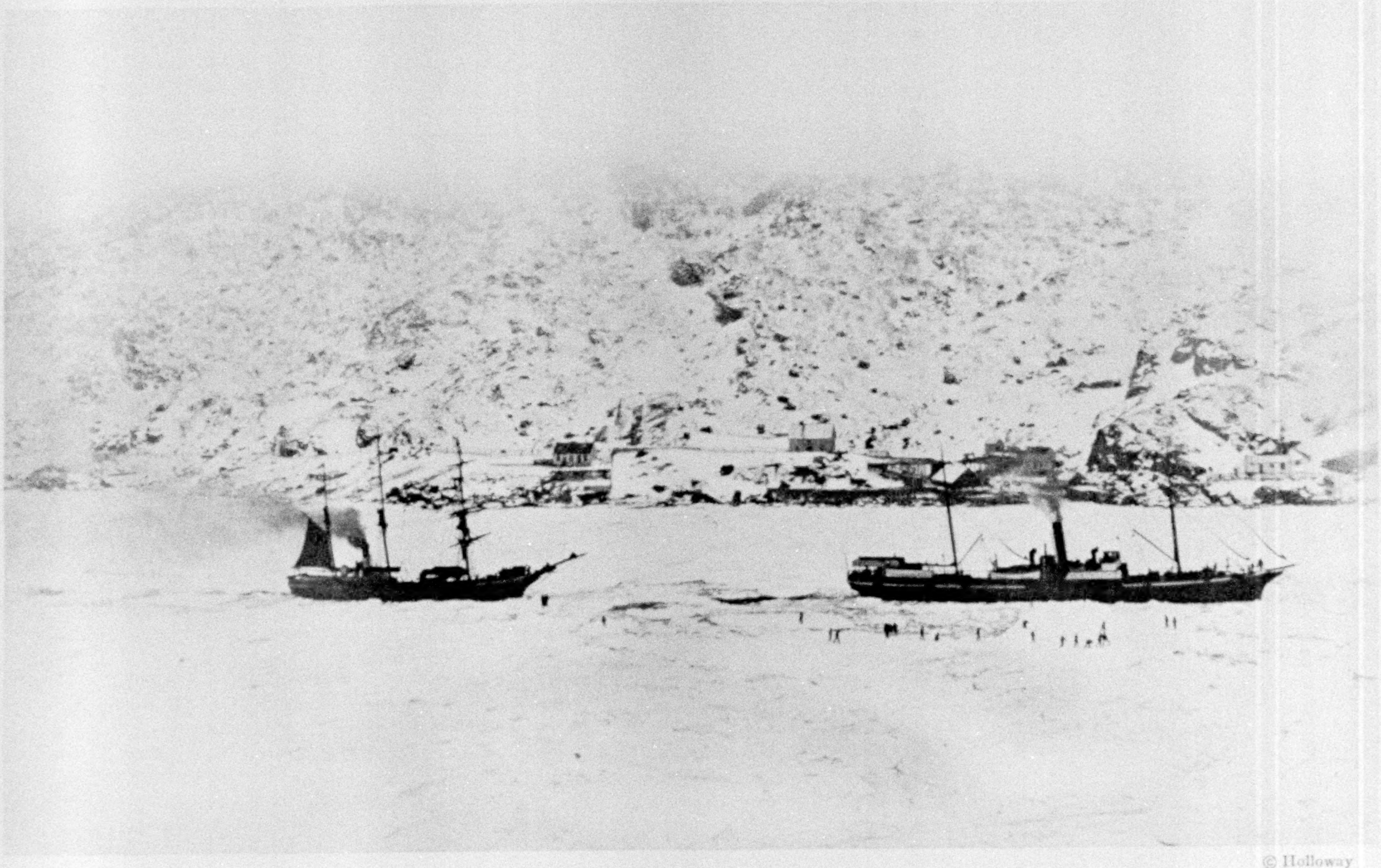


Photograph from Ernest Maunder

THE SEALING FLEET GOES THROUGH THE NARROWS AND INTO THE ICE

"Oh, the day we left St. Johns, my b'ys,
It was a very fine day!
Our wives an' sweethearts on the quay
Says they, ye'll understand;
Farewell, says they, remember me
To the swiles o' Newfoundland!
Our duff was hard, our pork was bad,
We had to drink pinnacle tea!
Hurrah, me b'ys, we'll make a noise,
An' by our gaffs we'll stand!
Me rope upon me shoulder,
Me gaff all in me hand,
Both day an' night 'tis my delight
To kill swiles in Newfoundland!"

—Sealer's song recorded by G. A. England.



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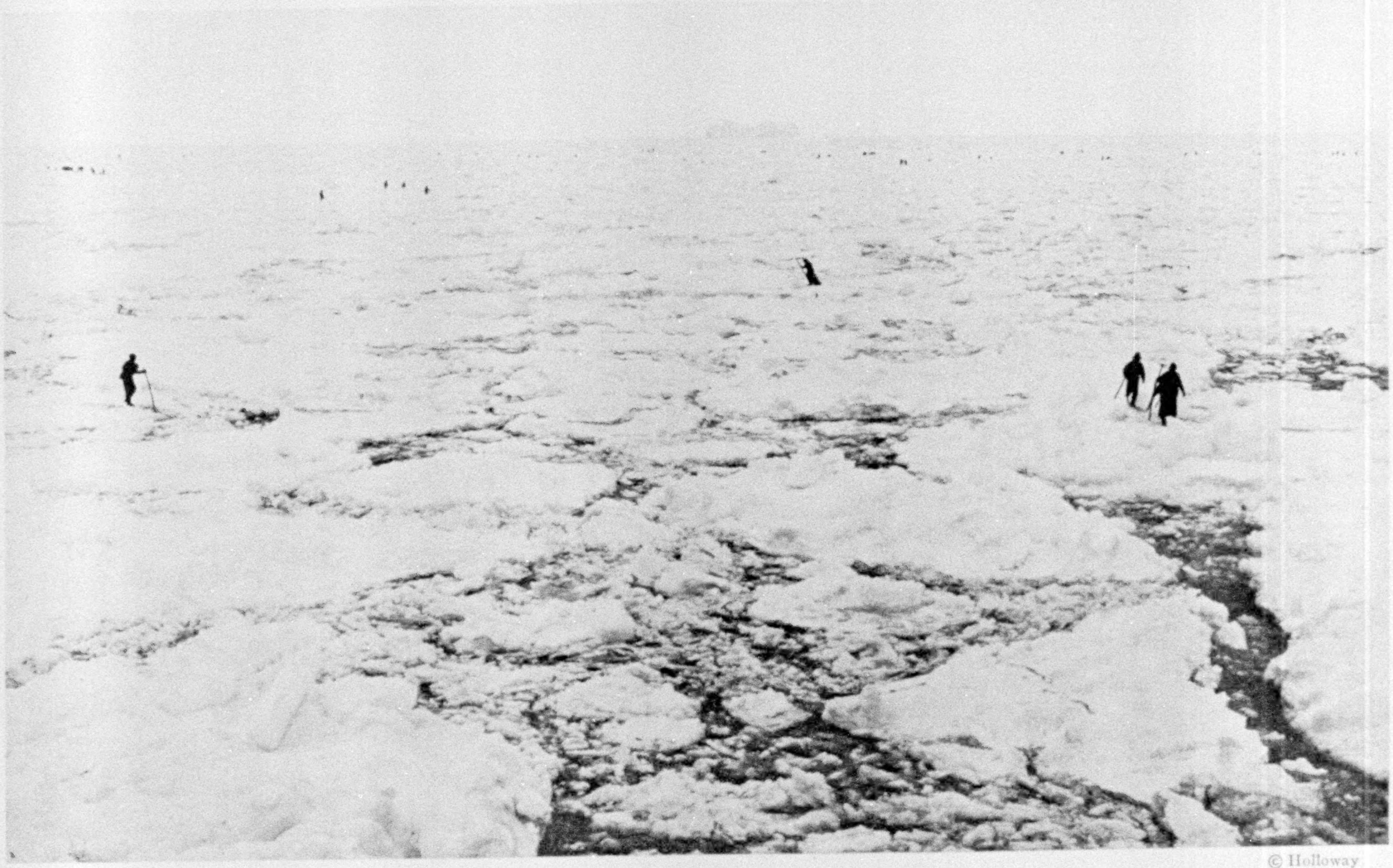
THE "GRAND LAKE" AND THE "KITE" POLING THEIR WAY THROUGH THE ICE OF ST. JOHNS HARBOR

Various are the methods employed to drive a vessel through the ice: dynamiting, rolling (see page 103), cutting ice, and poling. In the last-named method the crew, using long pokers or stabber poles, thrusts the ice broken by the armored prow along the sides and out of reach of the propeller. The *Kite* was the author's first command.



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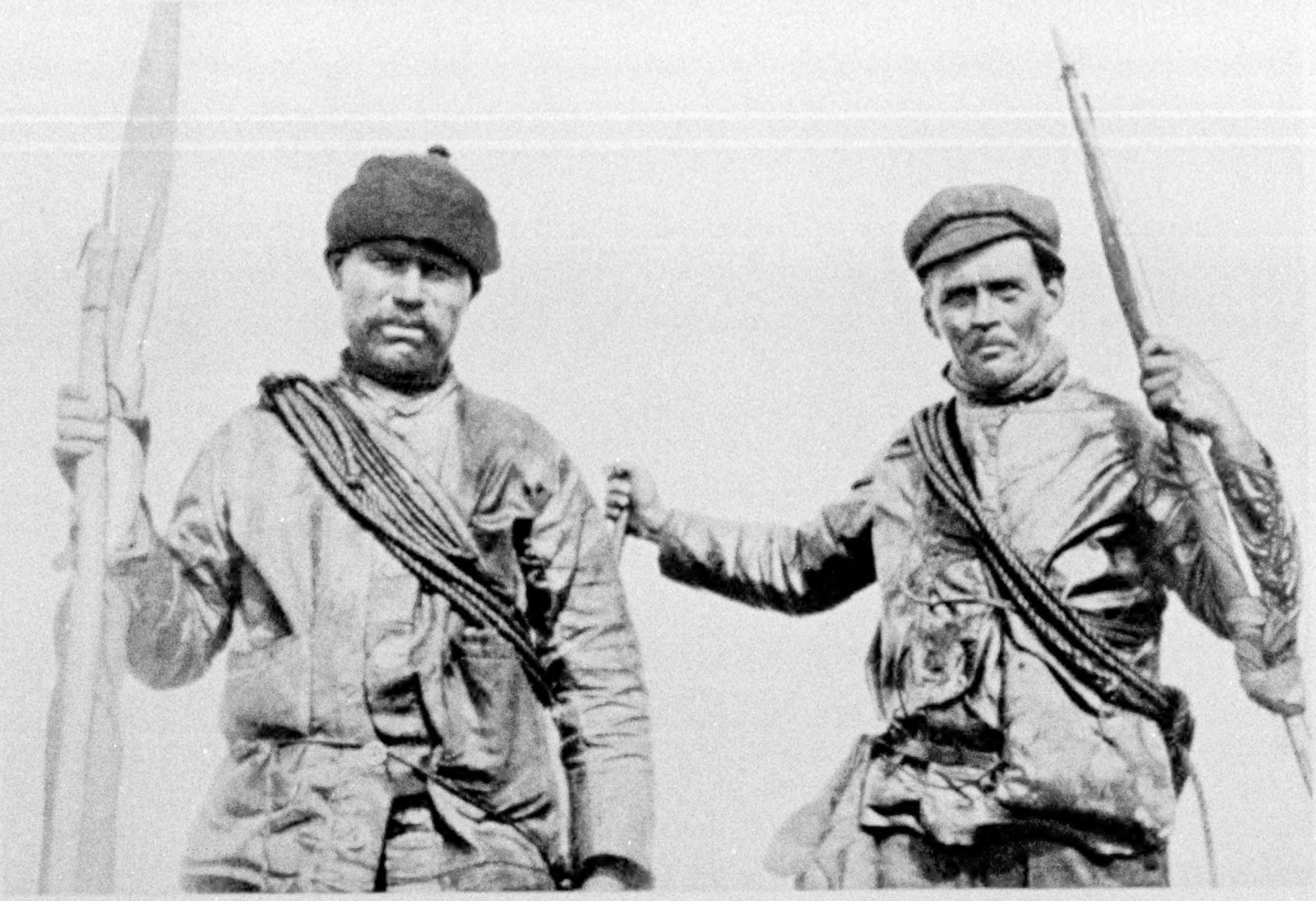
WALKING ON A MAGIC, MOVING CARPET

Sometimes the mosaic of pan ice is quiet. Even in strong gales waves do not form; but after a storm the swell rolls in and a man out after seals finds himself one moment poised on top of an ice hill and the next instant down in a valley whose white walls threaten to crash down on him. From the vessel it looks as if some giant were shaking the carpet, sending ripple after ripple across its limitless expanse. Note the iceberg on the horizon.



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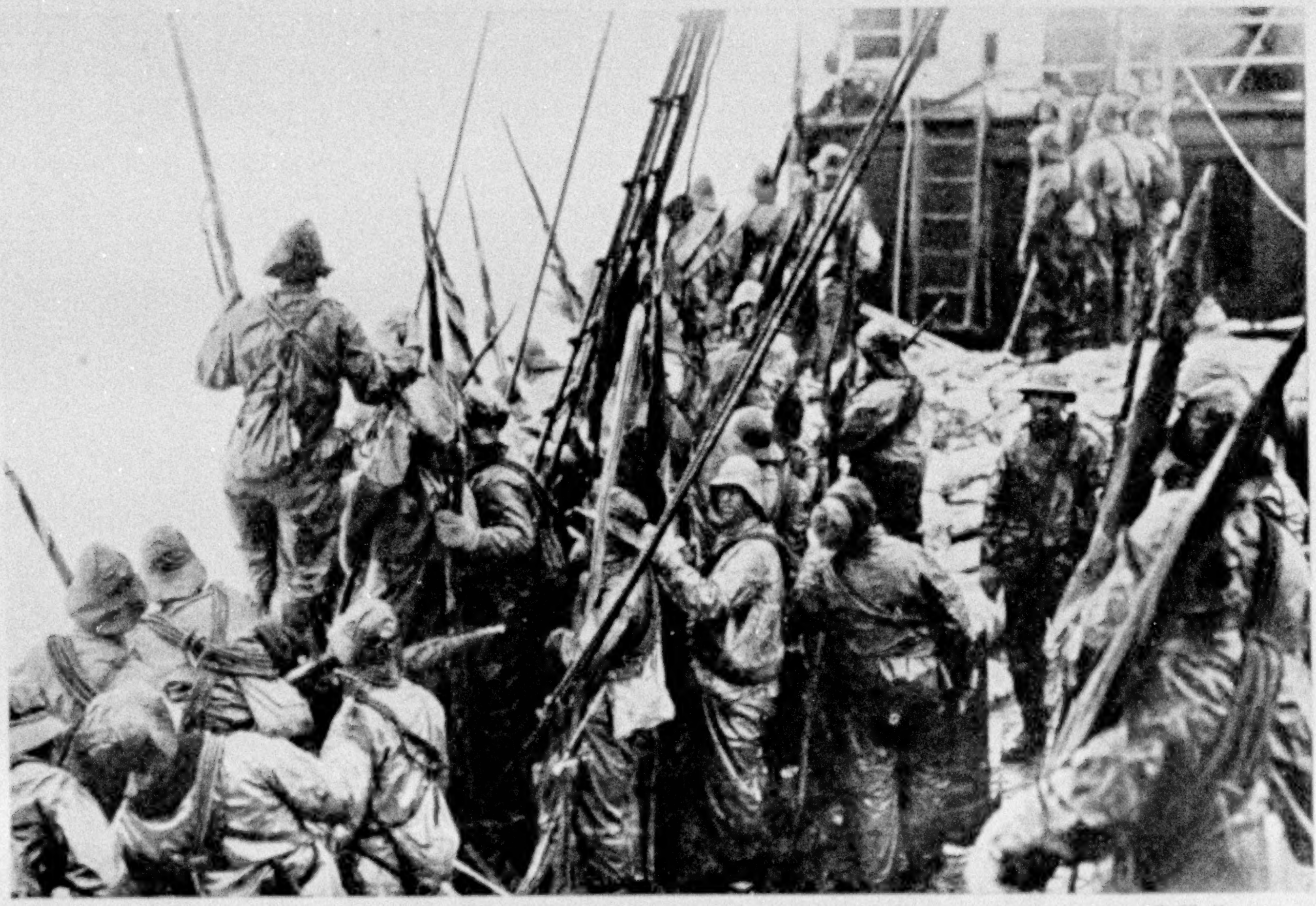
SEALERS IN WORKING "GEAR"

"You want men light and nimble, raw-boned fellows, small. Sometimes, to get light, we take off everything except our underwear and boots" (see page 95).



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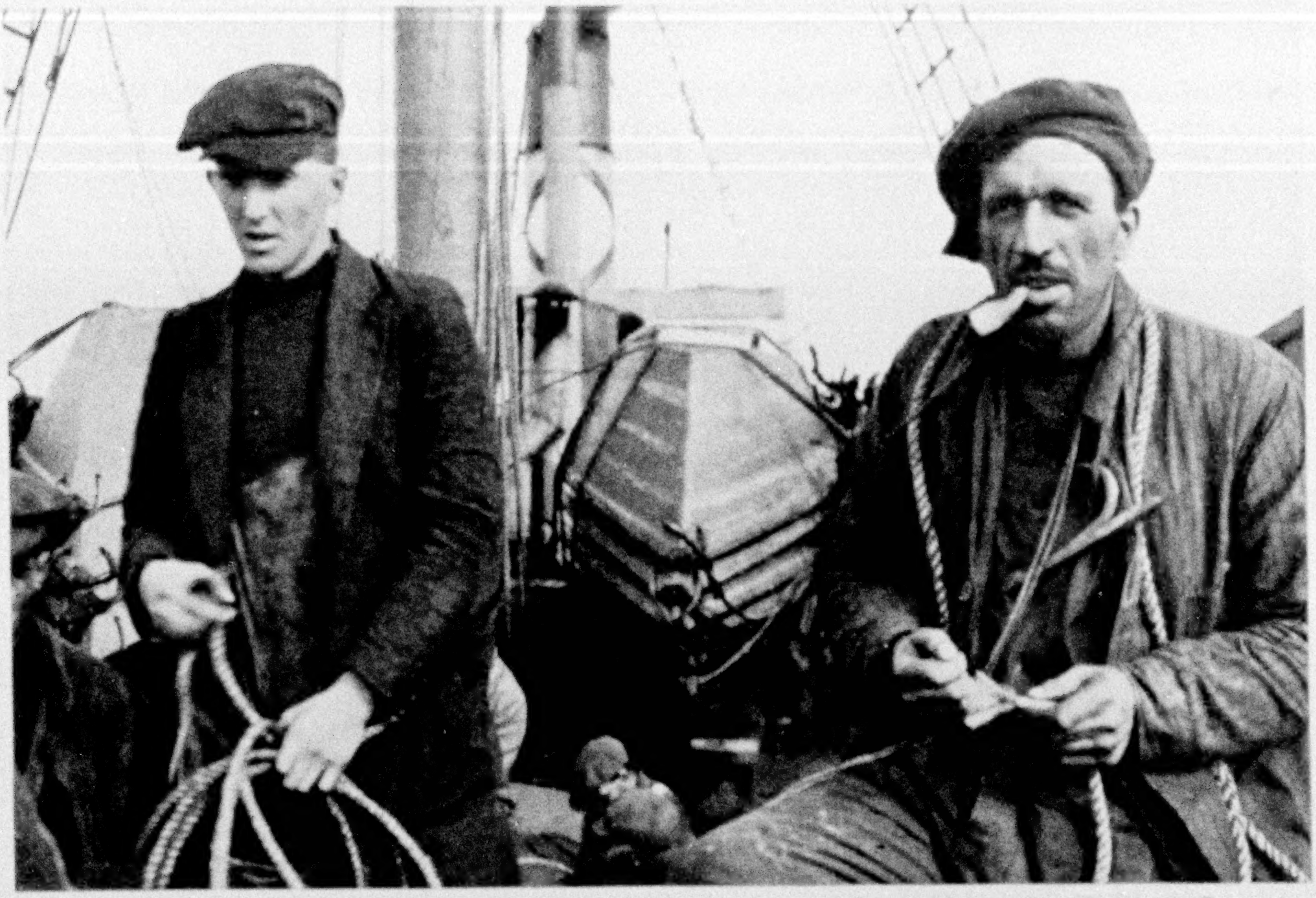
SEALS AHEAD! GET READY ROPES AND GAFFS!

Each sealer goes on the ice well equipped for the work and perils before him: ratline over his shoulder; "nunny" bag, with a lunch of orange, oatmeal, biscuit, and a bit of seal or pork, hung on his back; knife, sheath, and steel in his belt; goggles, compass, watch, and a water canister; and a stout bat in his hand (see text, page 124).



Photograph by Capt. Robert A. Bartlett

WHIPPING AND PUTTING EYES IN "SWILE" (SEAL) ROPES

A sealer prepares his ratline carefully. One end he loops into an eye, the other he trims and binds with spun yarn into a firm point. When he has sculped a seal he threads the point through holes in the pelt, then runs the point through the rope eye, draws the pelt into a bundle, and drags it to the marker (see text, page 124).

a sealer is charged with $12 to repay it, if any seals are brought in. Some men send the whole $9 home; others don't use it; and others buy tea, sugar, belt, sheath and knife, skin boots, oilskins, or tobacco.

If they think they are getting something for nothing, some of the sealers will buy anything—anything from a needle to an anchor.

The best trip I ever made sealing was in the *Bonaventure*, my first steel vessel. The details of it can go for the other sealing trips, too.

I had been lecturing around Chicago when one morning I got a telegram from a sealing concern in St. Johns: "Will you join *Bonaventure* as master, prosecuting gulf seal fishery this spring?" I wired "Yes," and got home the latter part of February.

The *Bonaventure* was a fine, strong, steel vessel of 1,500 tons, built expressly for the seal hunt—extra heavy beams and scantling (fore-and-aft braces), thicker shell plating, a rocker bow, and a heavy stern frame to carry a stout rudder and post.

Two hundred seventy men signed articles. The gulf sailing date fell on Saturday and we were already to cast off at noon. A northeast wind and a blinding snow filled St. Johns Bay with ice, so I decided to anchor in the stream and wait for a clear-up in the weather.

THROUGH FLOATING ICE THE SEALERS PUSH THEIR OBSTINATE WAY

Next morning was Sunday. The Narrows were still filled with drift ice, although the weather had cleared. The distance from our anchorage to the outside of the Narrows was about a half mile, and yet it took us all day to butt our way out. Ice choked the passage. Dark found us at North Head. The night being close, we waited until daylight. Next morning the wind dropped off calm, and with the ebb tide the ice moved seaward. In an hour or two we were in open water.

Then it was easy around Cape Race,

XUM

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INTO THE BARREL TO SPY FOR SWILES (SEE TEXT, PAGE 106)

right up to Port aux Basques, which is on the southwest tip of Newfoundland. In times gone by I have traversed this road in old wooden ships, with coal on deck and below, when head winds would make us run for shelter or be washed to pieces.

I had to get my clearance papers from the customs officer at Port aux Basques, but I could not go out before March 12. The other fleet, going down* the "old cow path" on the front of the island, clears from St. Johns. The gulf sealing ships clear from Port aux Basques to be near the sealing grounds.

At 8 o'clock the customs officer gave me clearance and I started out, with the wind blowing from 60 to 70 miles an hour, accompanied by snow. Anchored around and about us were several Gloucester schooners, among which was the *Arethusa*, skippered by Clayton Morrissey, the greatest fish killer out of Gloucester.

Trying to get the *Bonaventure* out of the harbor and clear of the schooners was like trying to get an automobile out of a Fifth Avenue traffic jam. It was a miracle I didn't tear away some of those schooners. We just shaved the main booms as we went out. We had to go.

Blow! How the wind blew!

We cleared Channel Head and we hauled up for Cape Ray. The ice was about 10 miles offshore and the lop (big sea) hove down from the northwest. The *Bonaventure*, with engines wide open, took them green over the forecastle, clean over the bridge. In about 20 minutes she was one solid block of ice.

SHIPS CAN STICK IN ICE, AS WAGONS MIRE IN MUD

With the coming of night the wind dropped, enabling us to make the ice—that is, get under the weather edge of ice, where the water smoothes. Here we lay until daylight next morning. At the first crack of dawn we were under way, following the leads and open water, and at length meeting the big level sheets of slob (new) ice. For a while we made good progress, but, on working in, the leads began to narrow and close up and the sheets got heavier. This slowed us down and at times we were stopped.

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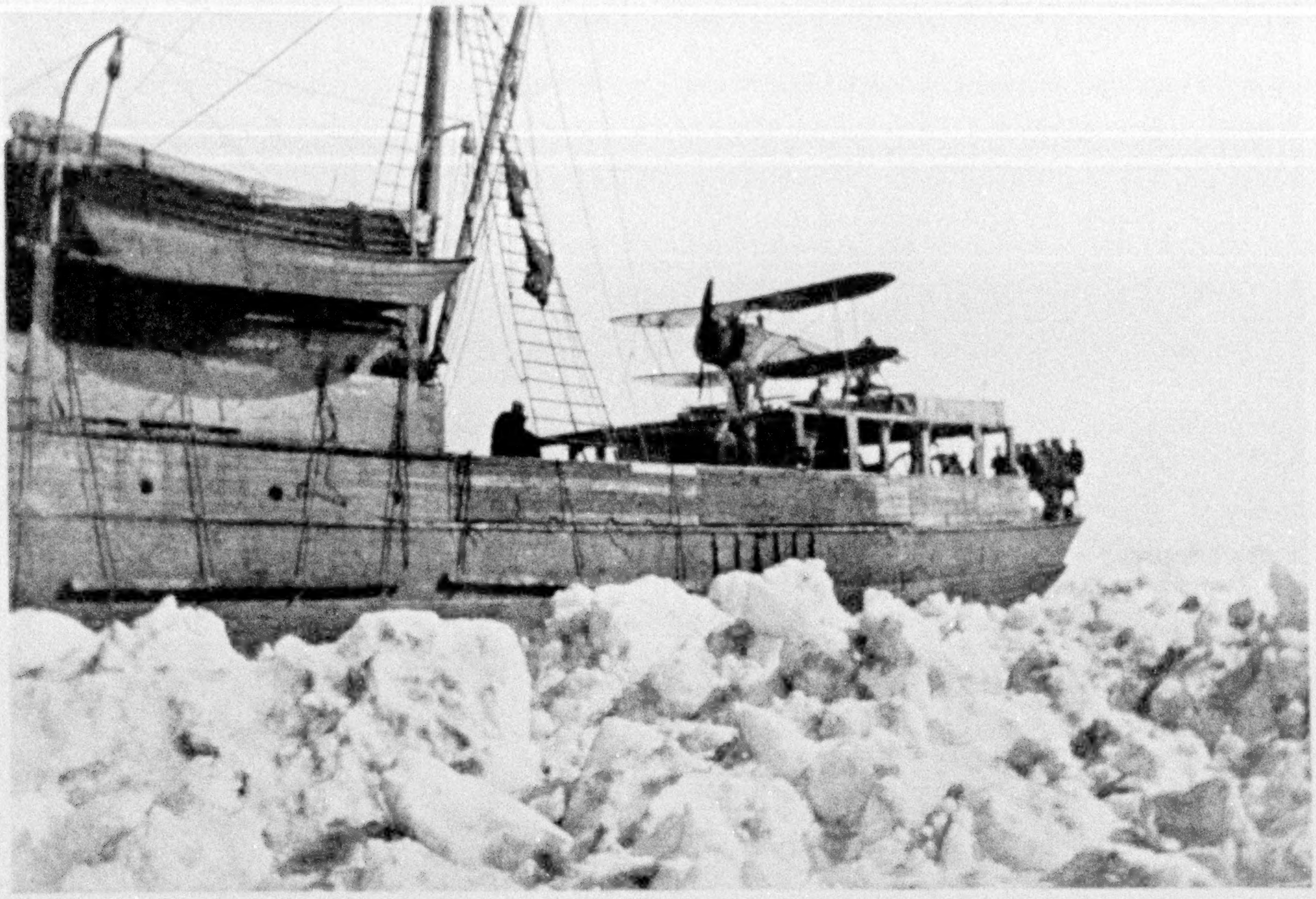
* Newfoundlanders speak of "down north" and "up south."



Photograph from Ernest Maunder

WHAT A BARRELMAN HAS ALWAYS WISHED FOR—WINGS

Airplanes are used in the seal fishery with great success. During the 1929 season the *Terra Nova* and the *Vedas,* out of Cape Breton, Nova Scotia, did not reach the seals until they were guided to them by an airplane. By virtue of this aid they filled up their holds with pelts. The usual practice is to fly the ski-shod planes from land.

As we broke the bars (the points at which the ice sheets impinge), the sheets would swing together, jamming the vessel. She could go neither ahead nor astern. Then we had to resort to all sorts of schemes to get her astern, so we could butt the ice again and break our way through. All hands got on deck and ran from one side to the other to roll the ship.

As long as you can move a ship in slob ice you can break it up and go along. But the *Bonaventure* was too heavy to roll, with all her coal and sealing gear.

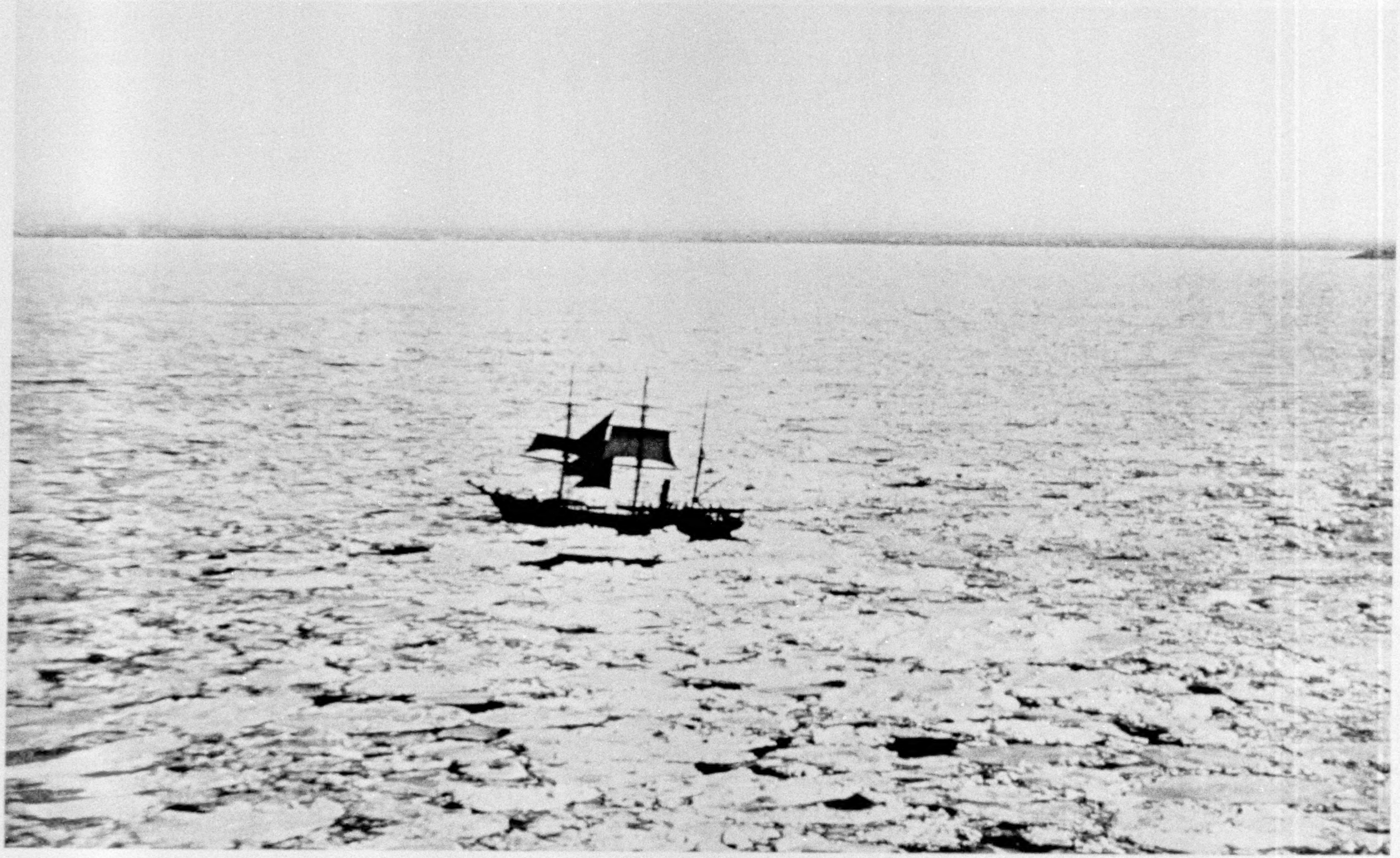
So then we put all hands out to free her, breaking up the ice around her sides. We made trenches with axes. This was slow. Dynamite was faster. We planted dynamite on one side and then on the other. Six shots at a time would shake up ice where it was nipping the *Bonaventure* and almost lift her out of the water. The engine, going full speed astern as the charge went off, would haul the vessel out of the trap. Then we would start out again (see, also, page 120).

This went on all day, and by next afternoon we reached the Bird Rock. The night was close and dark, so we lay under the Bird Rock until daylight. When dawn came I worked up under the lee of Brion Island, over toward the east cape of the Magdalens.

The Magdalen Islands are fringed, more or less, by dangerous reefs, which at this season of the year are covered with ice. We call it ballycada—technically, ice foot. The moderate northeast wind moved the ice offshore, so that I could follow along, but on two occasions the vessel scraped the bottom.

That night, at dark, I was well along toward Amherst Island, and we lay in the water between the ice and the land.

Before dawn I went into the barrel (crow's nest, or observation post) and, when light enough to see, I looked out on nothing but close-packed ice in the direction I wanted to go. It was too heavy for us to break our way through. A little later I was delighted to see all around the



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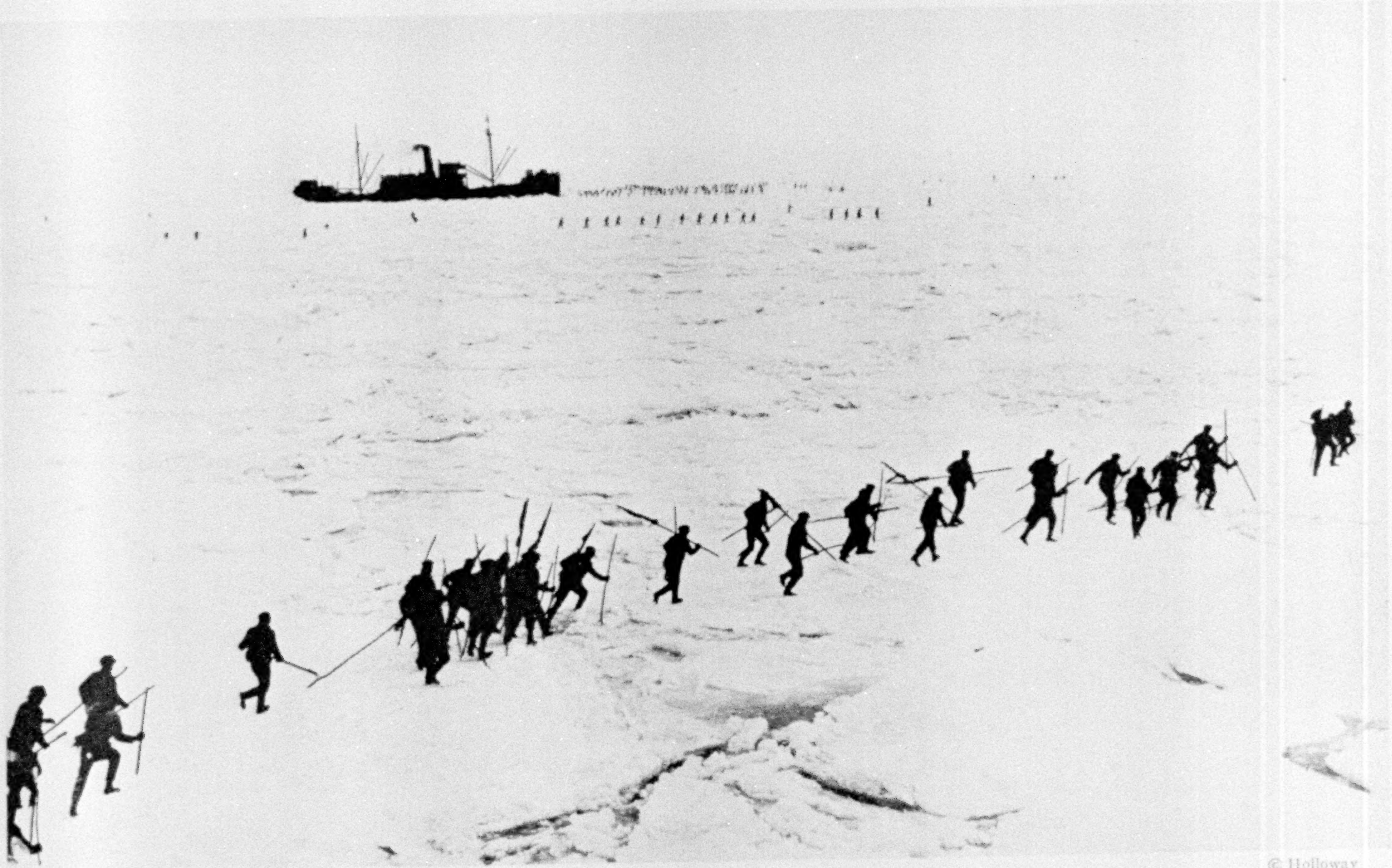
DRIVING THROUGH LOOSE ICE DEMANDS PATIENCE AND CARE

Newfoundlanders have an extensive ice vocabulary: "new ice" or "slob" is thin ice that "makes" in the "leads" and "swatches"—open water—between old "pans" or cakes; "sish" is very thin new ice; "pummy" is soft and ground-up ice; "old ice" is heavy ice that comes down from the St. Lawrence or from Labrador; "growlers" are pieces of icebergs or old floes; "rafted" ice has been tilted up by pressure; an "ice candle" is an icicle.



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ZERO HOUR FOR THE SEAL HUNTERS

Each captain strives to get his men into the patch first, but it seldom happens that he can find and have the "main patch" all to himself. More often several vessels of the sealing fleet reach the seal herd at the same time. Crew competes against crew, man against man. Hundreds of sealers advance over the white no man's land like waves of infantry.

Photograph by George Harding

"ALL ASHORE"

It's not "all aboard," but "all ashore," that brings Newfoundland sealers swarming up the sides of their moving vessel.

vessel schools of old harps, some of them riding the ice near by. Then I knew we were not far from the herd.

About 10 o'clock, as if Aaron had laid his rod on the ice, a vein of water opened just about the width of the vessel and in the direction I wanted to go. For an hour and a half we steamed in this vein of water almost without calling starboard or port.

EXCITEMENT REIGNS WHEN THE SEALS ARE SIGHTED

Sammy Wilcox, the barrelman, yelled down to me to stop the ship, so he could get a good sight through his 6-foot glass. The vibration of the engine interfered. In a second he stopped spying and looked over at me in the second barrel. "Sir," he said, "the whole ice is covered with young and old swiles" (seals).

I yelled out to the cooks, "Are the duffs ready?" When the men heard that, they knew there was something doing. Duff is "plum pudding," served three times a week. The vessel was alive with men running for their ropes, belts, gaffs, sheaths, knives, flags, and oilskins. It was half past 11 o'clock.

I imagine old Johnny Munden, the cook, and George Ackerman, two men grown gray in the sealing service, when they saw the old ones in the water early in the morning, and the speed and direction of the ship, knew that the captain would want the duffs ahead of the usual time. While the men were getting their duffs, I got the vessel into a position for a good evening's work.

Imagine yourself in Central Park surrounded by thousands of sheep and newborn lambs. This is what it looked like. The seals were all together on very large sheets of level ice. This was very unusual for the gulf, and I have never seen the like of it before or since.

"All hands ready!" I shouted. "Ropes and gaffs!"

I put one watch crew on the starboard side, one on the port side, one ahead, and one astern—four watch crews—234 men on the ice. They began killing and panning the seals, knocking them on the heads with a gaff, slitting the carcasses along the belly, removing the sculps or pelts, and hauling them to markers. Markers are colored flags, like golf flags, stuck in the ice at each pile of sculps, so that the captain can return and pick up the pile as the men move on to another patch of the herd.

IN ONE AFTERNOON 8,000 SEALS ARE TAKEN

While the men were at work, the ice allowed me to drive the ship deeper into the herd, so the crew could start from a new base on the next day. We left the first day's catch on the ice. The crews killed some 8,000 seals that afternoon—all young ones, because the "whitecoats," or newborn seals, are the sealer's first choice.

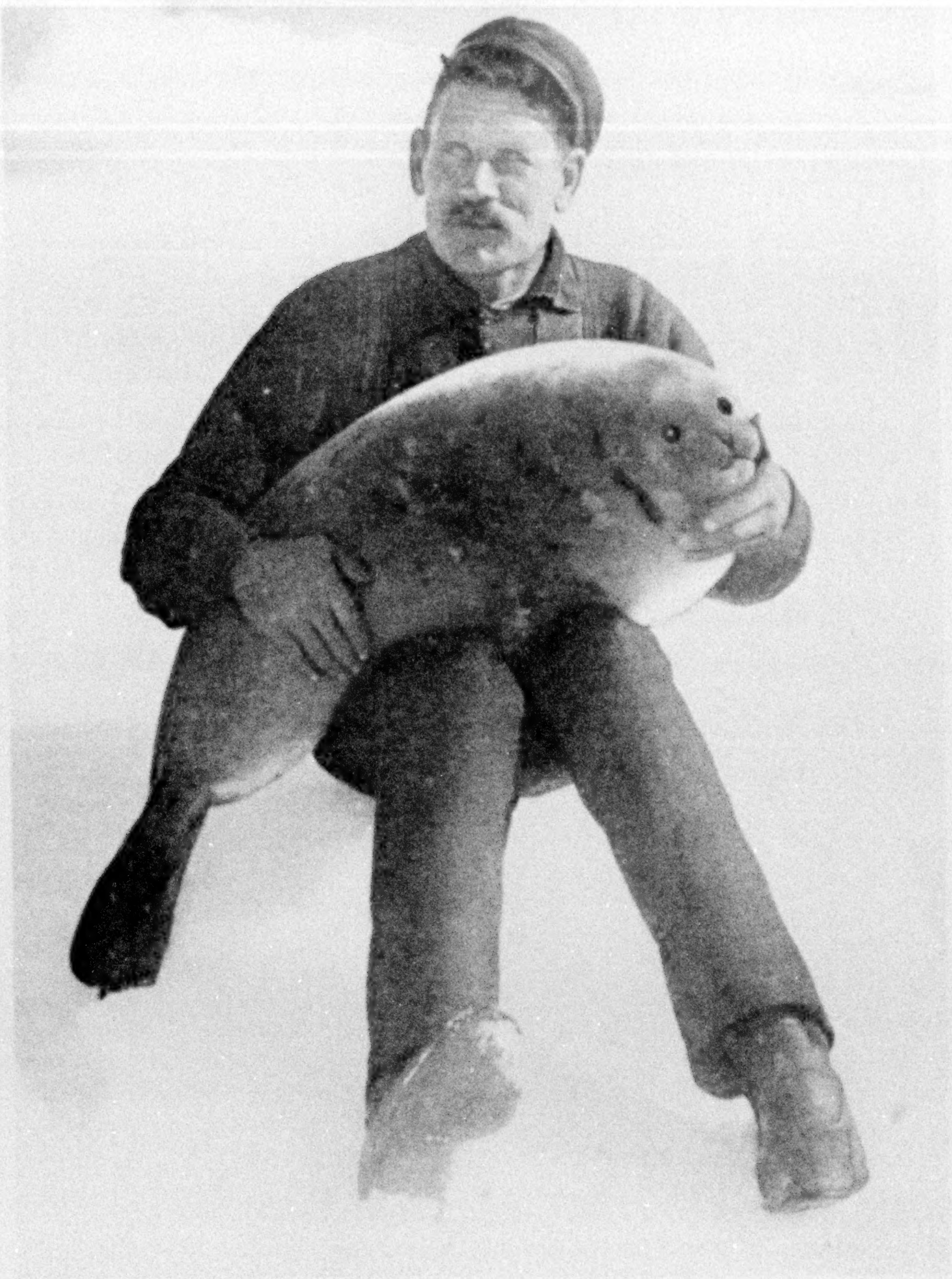
For three full days the kill went on from daylight to dark. All this time the ship was jammed in the ice, preventing us from picking up any seals.

Finally, when the ship couldn't advance any farther, we began to haul sculps over the ice to the vessel. On the fourth day a furious gale sprang up from the west, with blinding snow and freezing weather. Seals and ship drove down on the Cape Breton coast; the ship came within a half mile of shore off Cape St. Lawrence.

The ice, rafting (telescoping) under the force of the gale, threw down our markers. I was up in the barrel and could see them going down one after the other. Our work was being buried under ice. Sculp piles that weren't buried drove out of the gulf out of our reach, while the *Bonaventure* remained jammed in the still ice under land.

Some of our pans wheeled in against the shore ice under Cape St. Lawrence and Cape North, where the landsmen went out with teams and took many skins. Later on, when I got clear, I picked up pans in the mouth of the Bras d'Or Lake, and some in the mouth of Sydney Harbor, and others out around Scatari.

Weeks after, the "bankers," going up for fishing off Cape North, passed through



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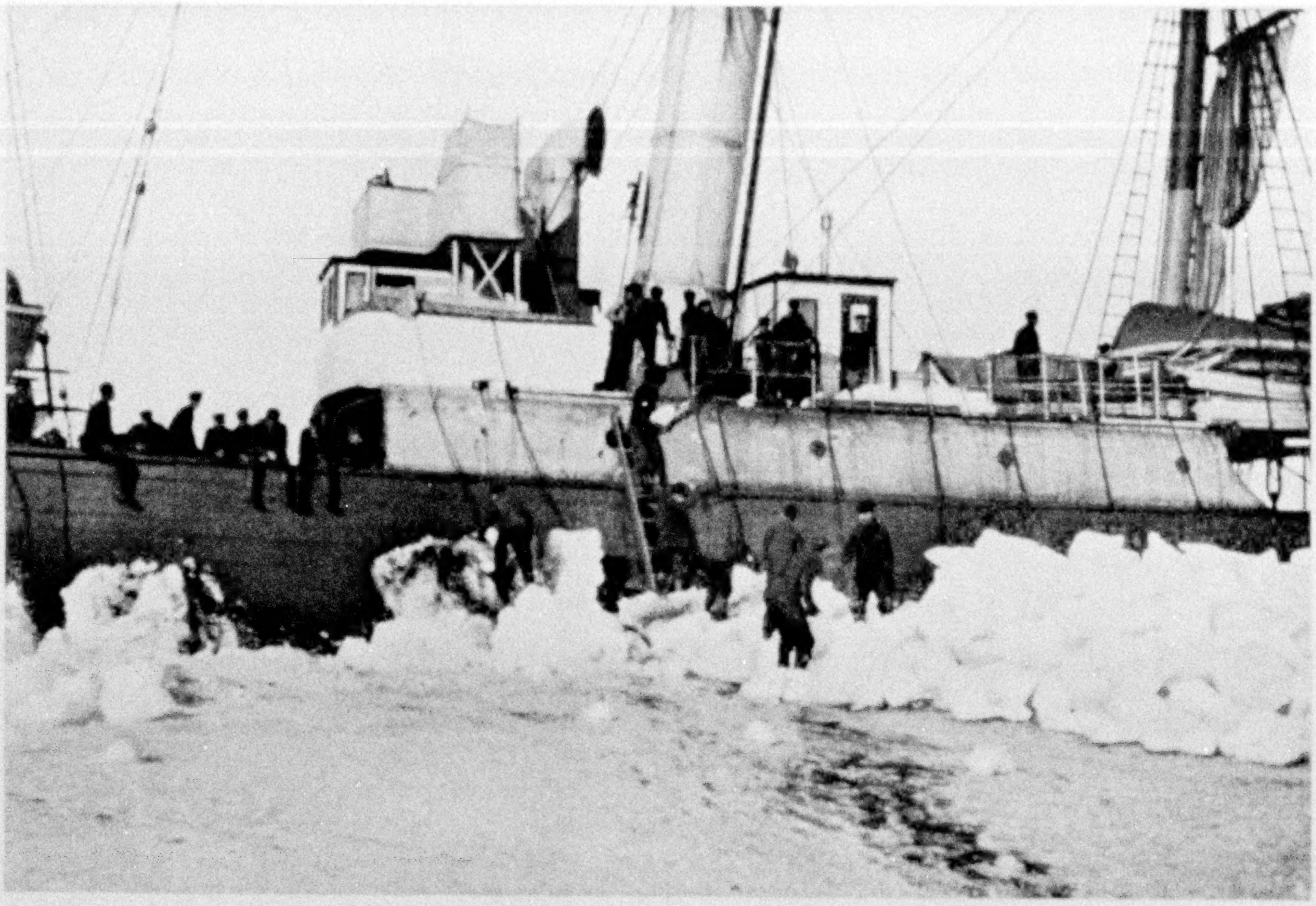
NEITHER WILL EVER GO ON THE STAGE

Harp seals do not play heavy leads in vaudeville or circus. Scientific truth requires the blasting of the acrobatic-seal myth. Ball-tossers of the footlights are "flapper" *sea lions* hailing from California beaches. Harbor and fur seals live contentedly in many zoo parks, but neither harp nor hood seals have been maintained in captivity successfully. A few young harps brought to the Bronx Zoo soon died of tuberculosis.



Photograph by Harry Whitney

LOADING "PINNACLE TEA"

When need for a supply of fresh water arises, the captain sends men overboard to cut pinnacle ice (see page 123). As sea water freezes, the first ice formed contains little or no salt. In this way stronger and stronger brine is concentrated in pockets and freezes only when the temperature becomes very low. These salt pockets are first to melt when the temperature rises. They drain out wherever openings permit, as in ice uplifted in thin sheets or fragments. Thus pinnacle ice, though still frozen, may be practically free from salt.

many hundreds of floating pelts from shattered floes. Our pans were scattered over the whole ocean!

By labor and search we salvaged 26,000 pelts—only about half the seals killed—but it was the biggest catch ever brought out of the Gulf of St. Lawrence until my father last year brought out 30,800 sculps.

NOT ALL SEALS ARE SLAIN FOR FUR ALONE

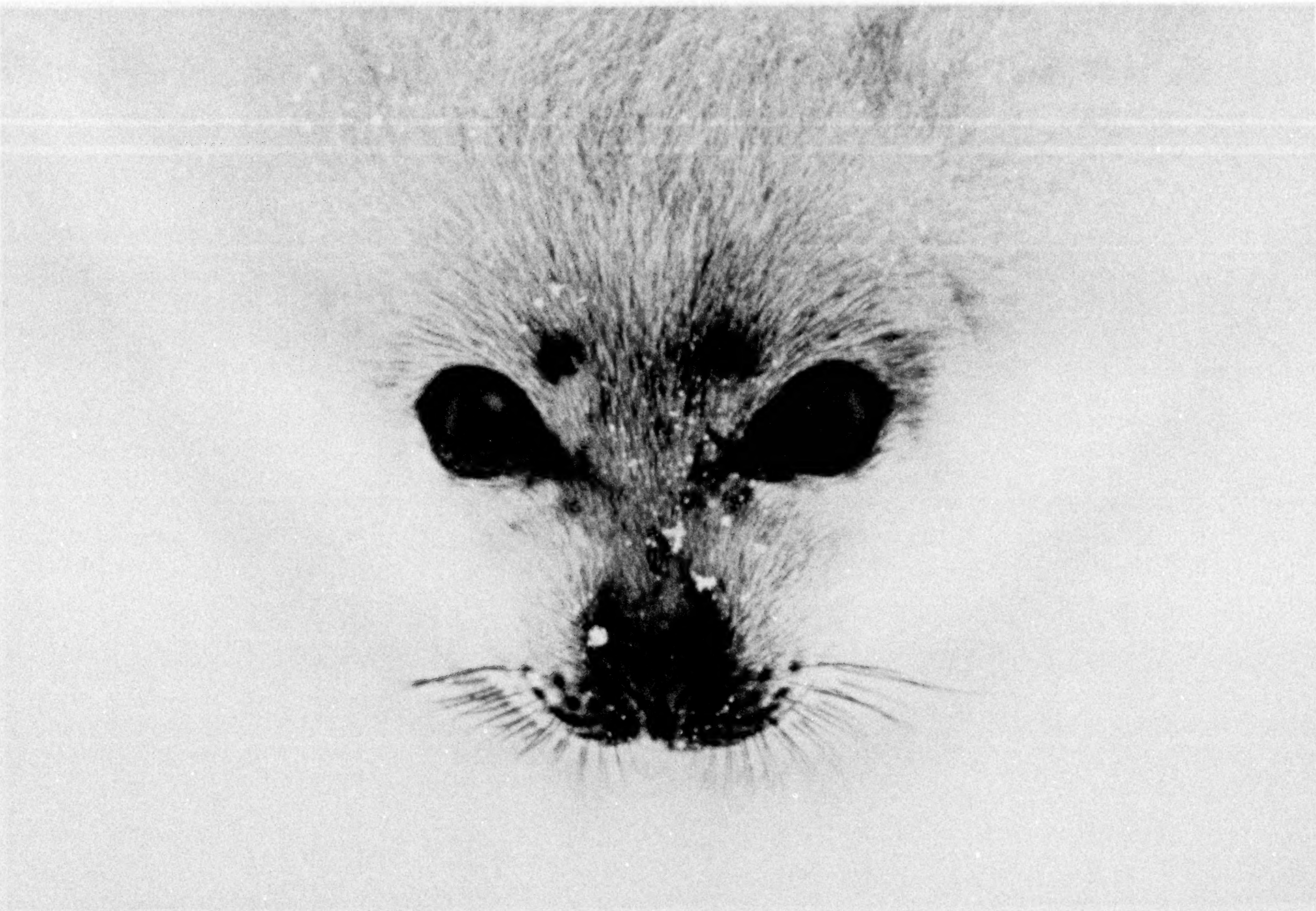
Where do these seals come from?

What kind of seals are they?

I went to the Pribilof Islands, in Bering Sea, last year. The Pribilof seals are different from the harps and hoods that we hunt off Newfoundland. The Pribilof is a fur seal (near relative of the sea lions) and its skin is used for making beautiful coats, worn by fair ladies to give them an air of distinction. It hauls out on the land. It pups or whelps on the land, while the harp and the hood haul out on the ice to give birth to their puppies. We call it seal "fishery" in Newfoundland, because the Atlantic seals live as much in the water as cod and haddock. During the season of Lent the sealers eat the hair seals just as they would fish.

When I tell girls about the large number of seals we get off Newfoundland, some of them say, "Why don't you bring me a coat?" I feel like thirty cents, knowing I can't comply with their wishes. Well, I am sorry, I tell them, but the seals we go after are the hair seals, and all they are good for is to make soap and pocketbooks.

There are several different kinds of seals around the shores of Newfoundland and the Gulf of St. Lawrence: the square flipper, the horsehead or gray seal, the jar or ringed seal, the bay or shore seal, the harp seal (*Phoca grœnlandica*), and the hooded seal (*Cystophora cristata*). The harp and the hood are the two kinds that we hunt in our sealing vessels. The first four varieties mentioned hang about Newfoundland and other northern waters, in



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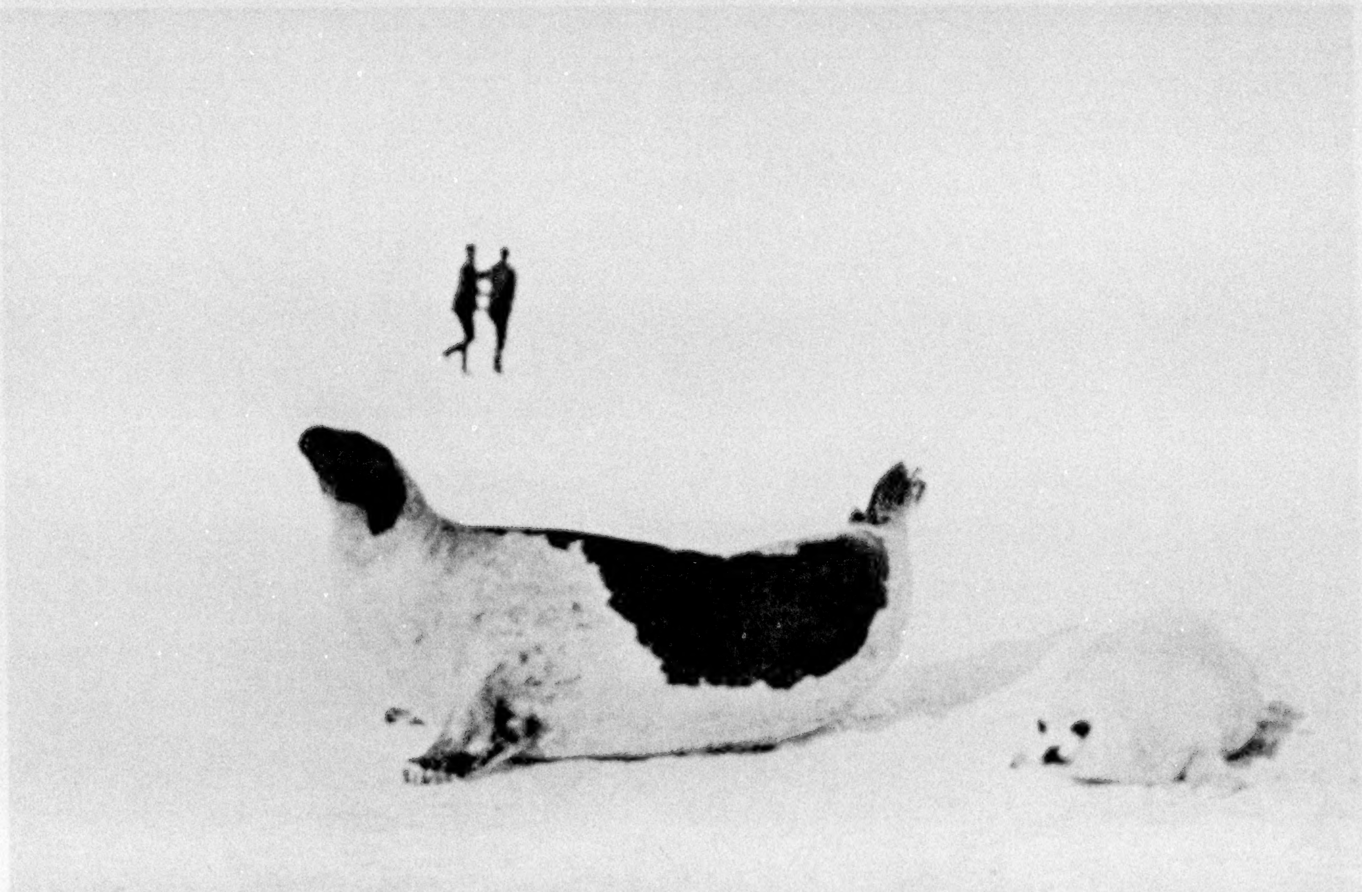
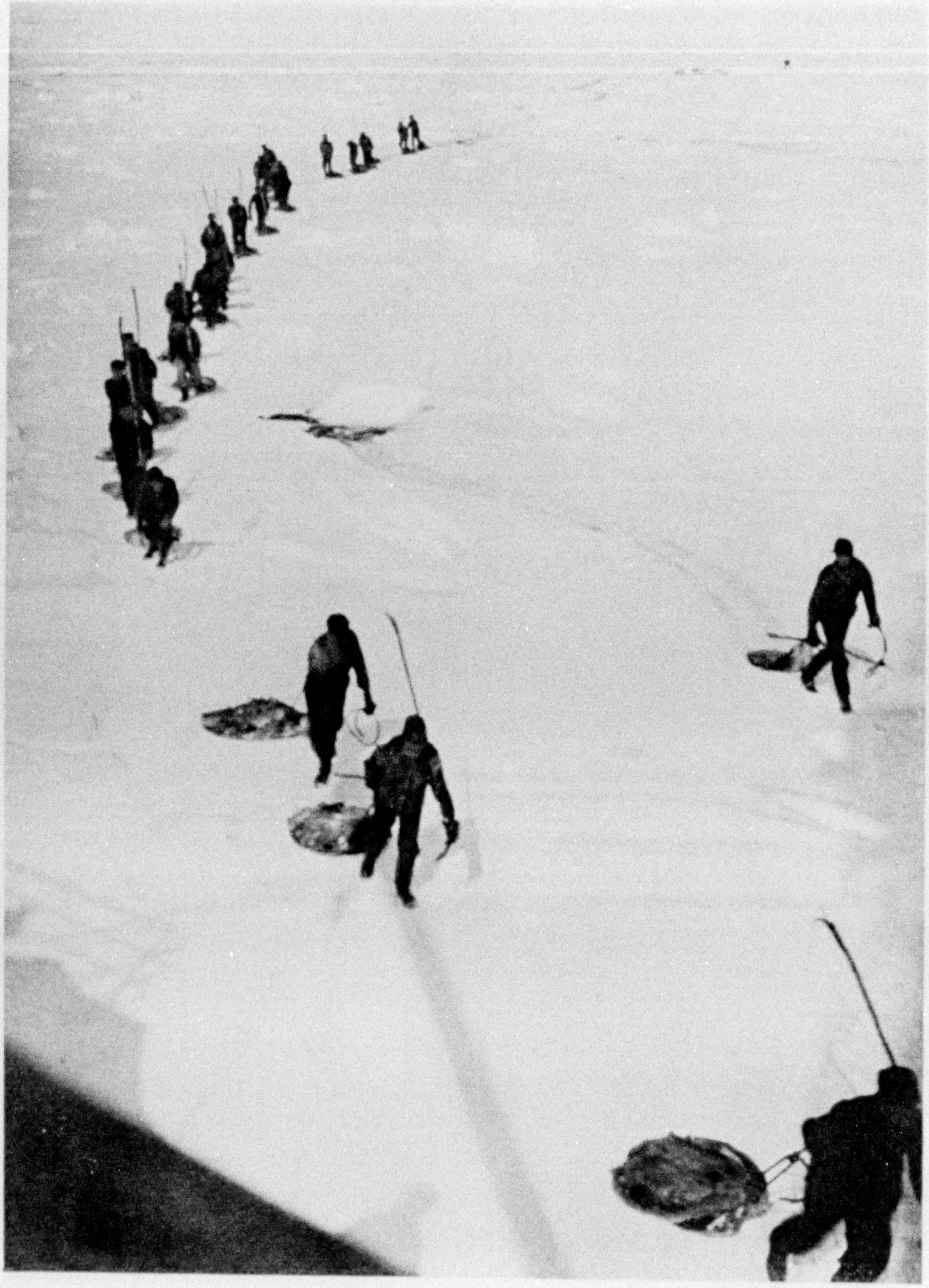
"THE BABY HARP LOOKS LIKE A FLUFFY WHITE MUFF WITH TWO LARGE, LIQUID BROWN EYES PEERING OUT"



© S. R. Oakley

HOW THE HARP SEAL GETS ITS NAME

The shape of the patch on the back of members of this species is supposed to resemble the outline of a harp. Scientific knowledge of the migrant seals is still incomplete. Whether young "whitecoats" suckle or whether they lap up their mother's rich milk from the ice is a moot question. The harp is also known as a saddle-back or Greenland seal.



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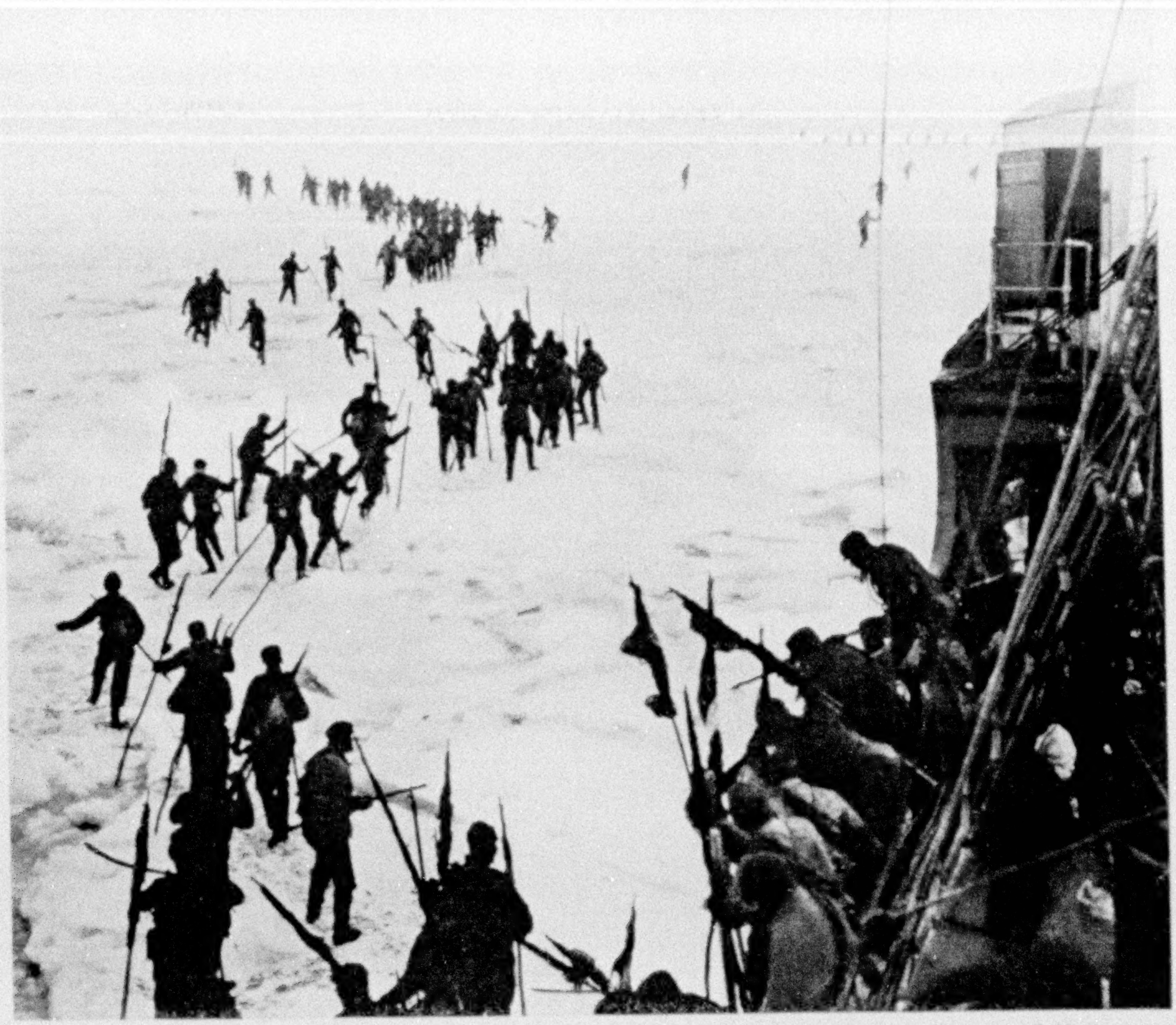
THE GREATEST SEAL HUNT IN THE NEW WORLD

Seals inhabit all the oceans and are taken by hunters on many shores. The protected fur-seal rookery of the Pribilof Islands is expected to yield 33,000 pelts this year. Newfoundland's annual seal fishery nets about 200,000 pelts. Possibly the Norwegians and Russians together take more seals over a broad area from Greenland to Novaya Zemlya, but accurate figures are lacking. The islanders nurse the hope that a process can be discovered to make the fluffy fur of a whitecoat hold fast to the skin. Such a development would put Newfoundland on a par with Alaska as a seal-fur producer. Only the soft coat of a "cat," a stillborn Newfoundland seal, is tight enough to warrant the skin's use as apparel.



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WHEN A SKIPPER'S WORRIES BEGIN

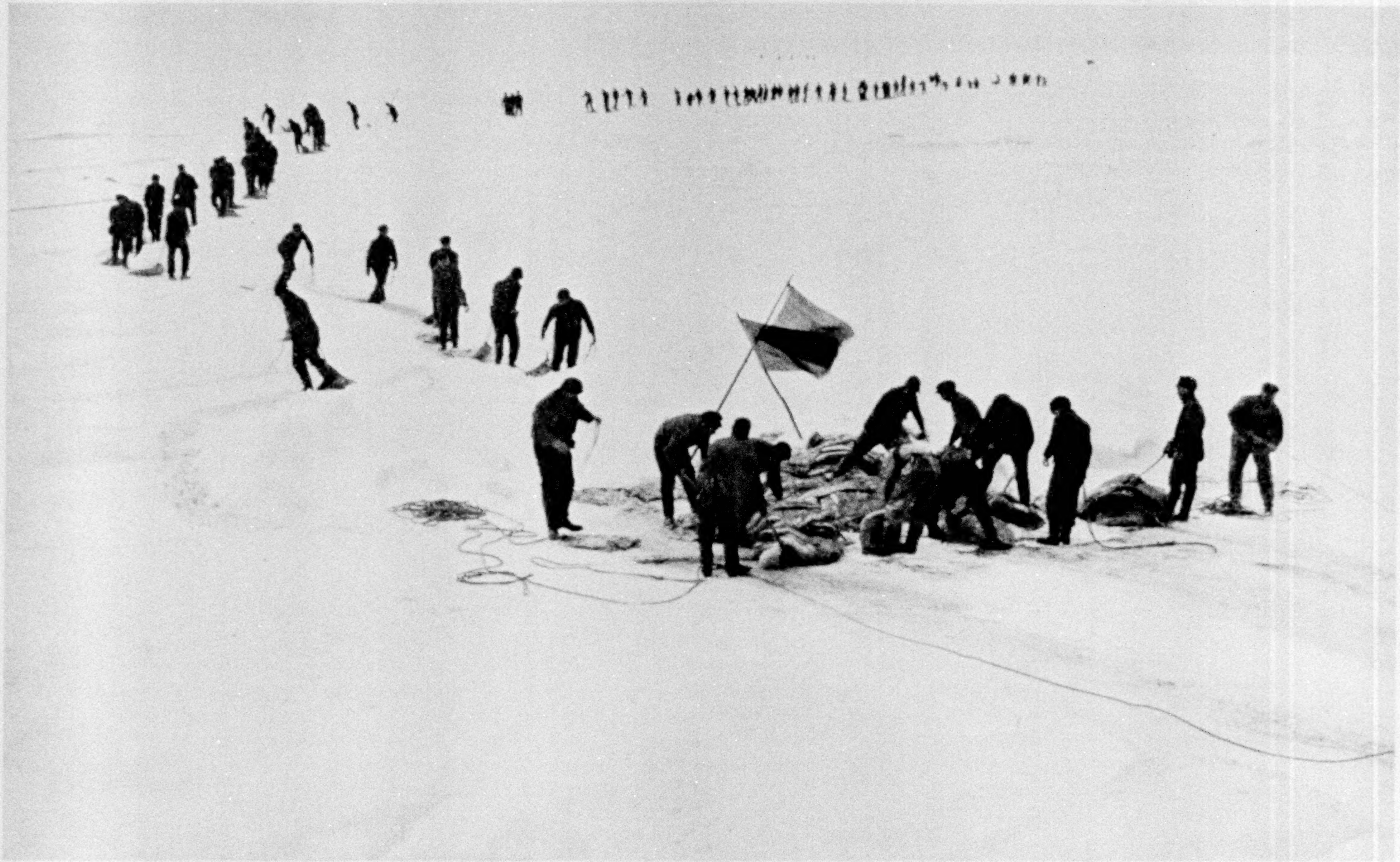
No captain is at ease when his crew goes on the ice. Stormy March bears many an ill wind imperiling sealers. Men have been lost on the ice in blizzards and fogs, but weather reports by wireless from Toronto and Washington have reduced the dangers and casualties of the seal fishery.

small groups, but only the hood and the harp herds beat away to the northward and return to their whelping grounds in an annual migration over 2,000 miles of ocean.

ESKIMOS TRAP SEALS IN NETS AS BIG HERDS MOVE IN SEASONAL MIGRATIONS

While on Arctic expeditions in recent summers I have frequented Jones Sound and the north water of the whalers, and there I have seen large schools of harps. In talking with the Eskimos and the white residents of Baffin Island, Hudson Strait, and Labrador, they told me of the migration—how in the spring they catch the seals in nets and weirs, as the herds work north along the Labrador coast and across the Hudson Strait and its northern shore, on north along the harbors and inlets of Baffin Island and Ellesmere Island; and again, in October, when the herds return, the Eskimos and livyeres (whites who live permanently on the Labrador coast) set their nets.

The hoods come south, along the west side of Greenland, a little later than the harps come along the Labrador coast. When the former reach the end of Greenland they go across about 500 miles of open sea to the Labrador coast. The harps come on down, and in the month of January they are off Battle Harbor. They continue southward to the Grand Banks, where they fill up with cod, herring, and capelin. They get well fattened, so their newborn pups may have rich milk, showing how wise are the workings of Nature.



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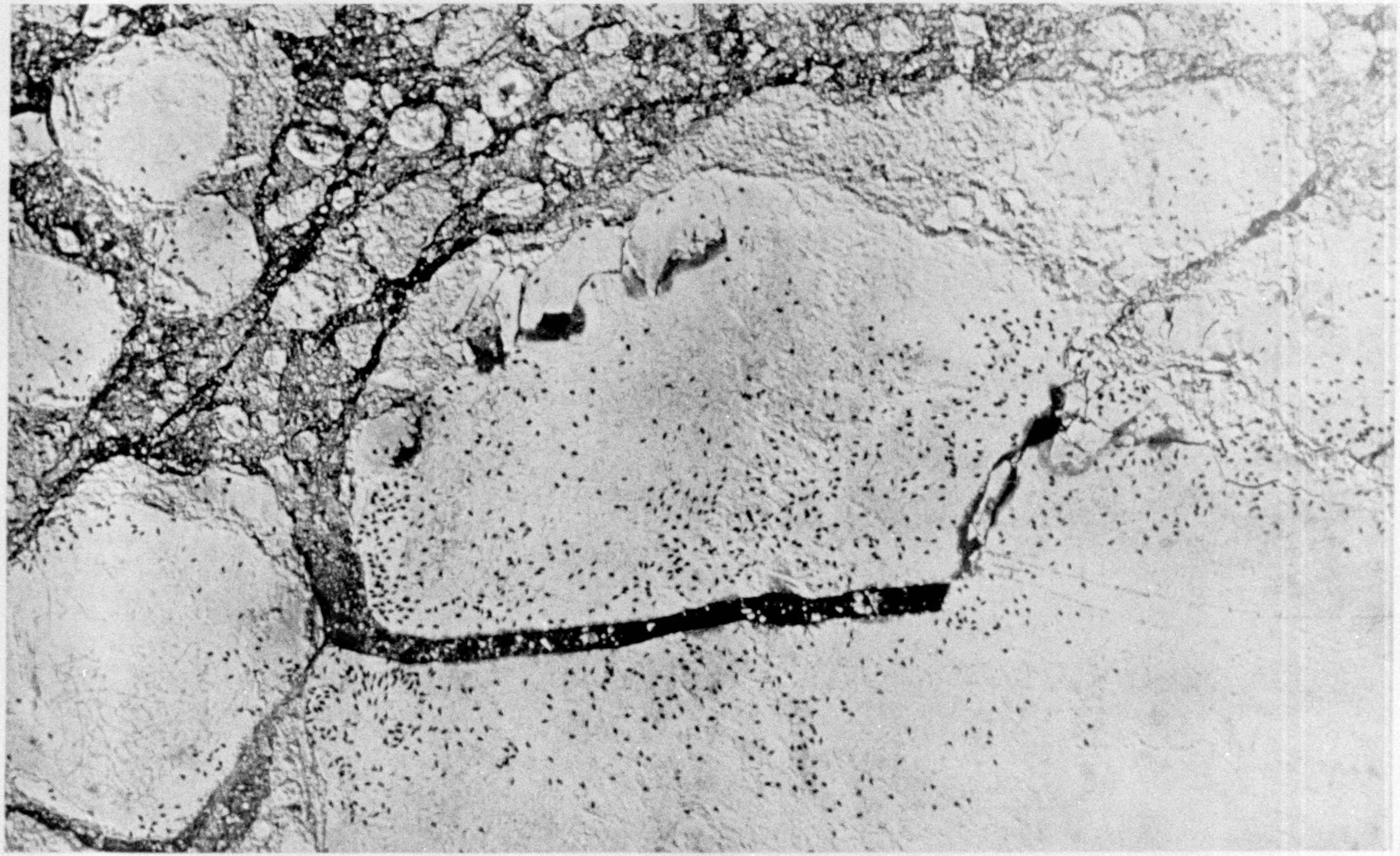
HAULING SCULPS TO A MARKER

A sealer can drag three to six pelts to a marker at one time. A "gert feller" can skin a seal in a minute; some have done it in 40 seconds. Any sealer who can kill, skin, and pan 120 in a day is a good hand. Men have been known to do 300 in a day (see text, page 125).



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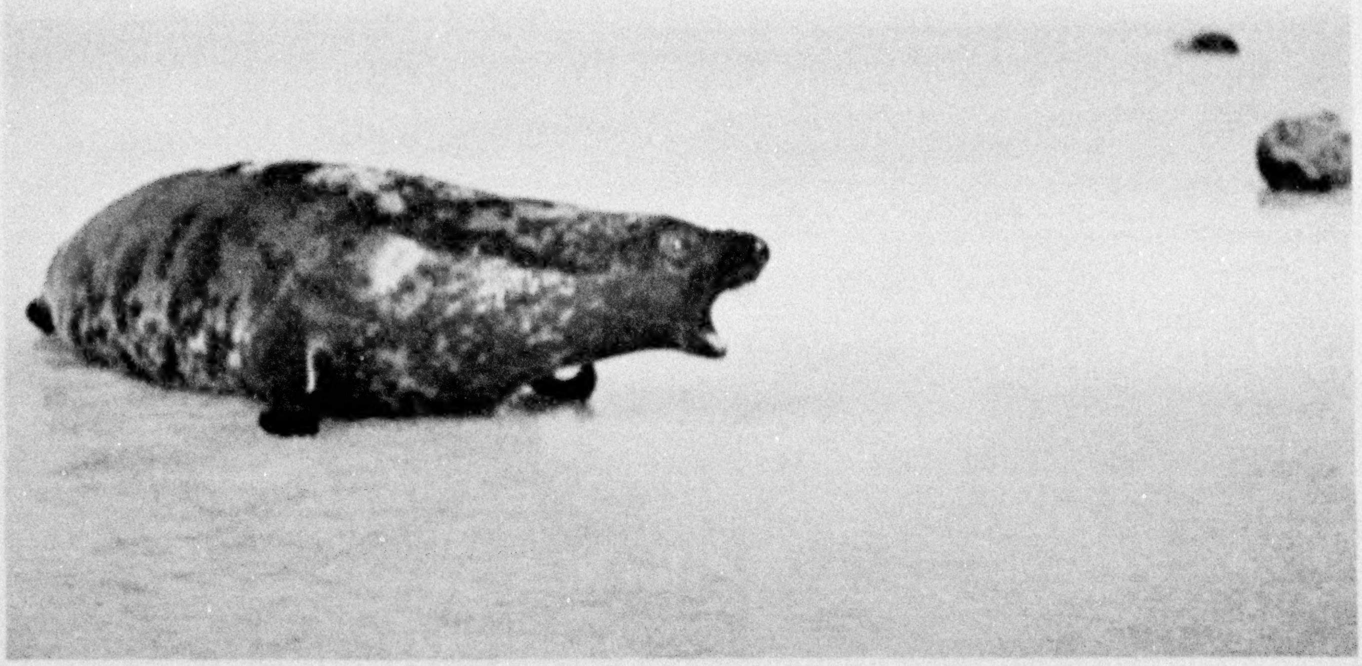
NOT ANTS ON A GARDEN FLAGSTONE, BUT SEALS ON ARCTIC ICE

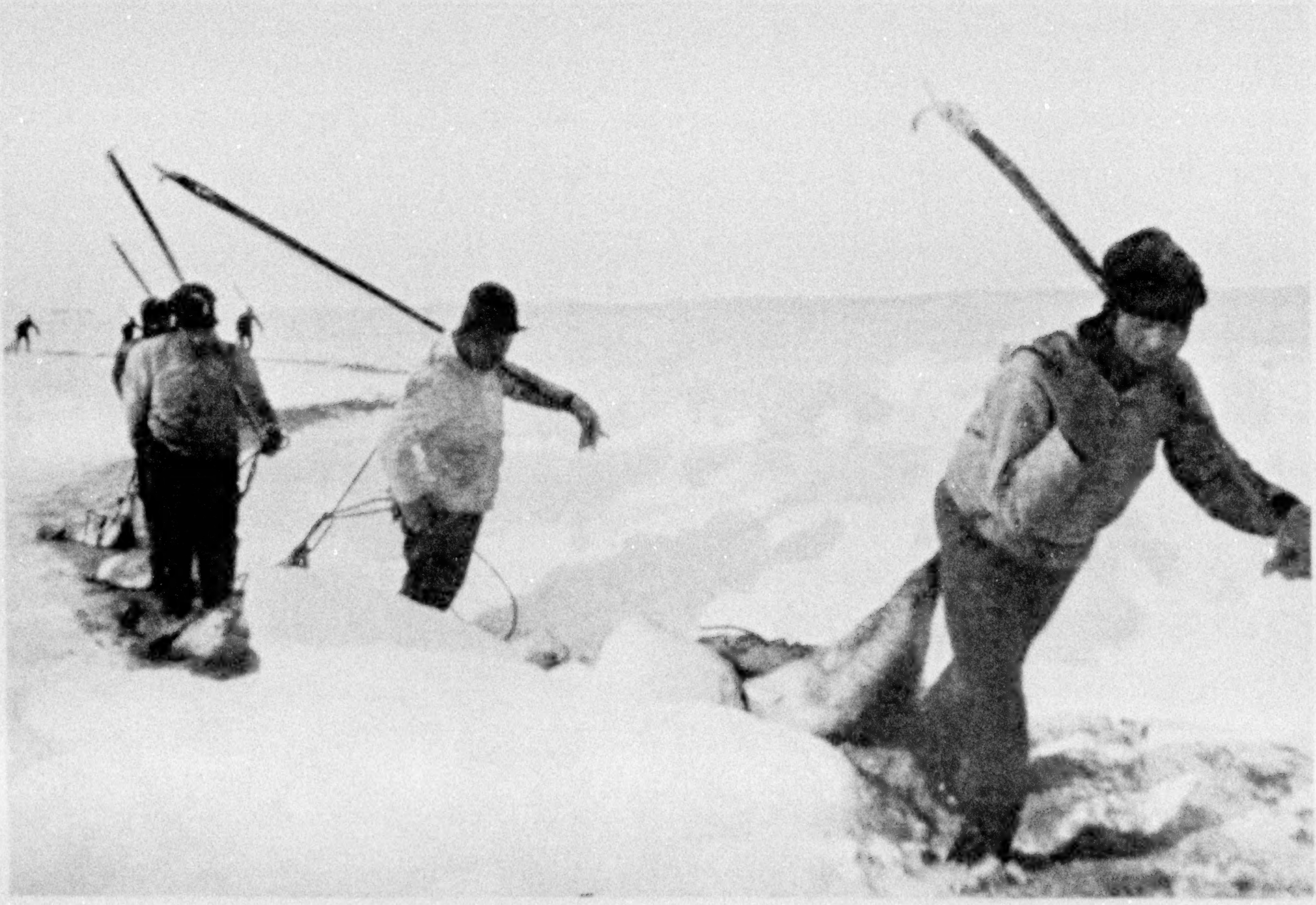
These seals, spotted by a Russian seal scout plane somewhere off the entrance to the White Sea, gather in herds at the breeding season. Still another seal herd is known to migrate in the ice-filled waters between the east coast of Greenland and Jan Mayen Island and Iceland. Norwegians as well as Russians take part in the seal hunts in waters north of Europe.



Photograph by Harry Whitney

A HOOD SEAL SHOWS FIGHT

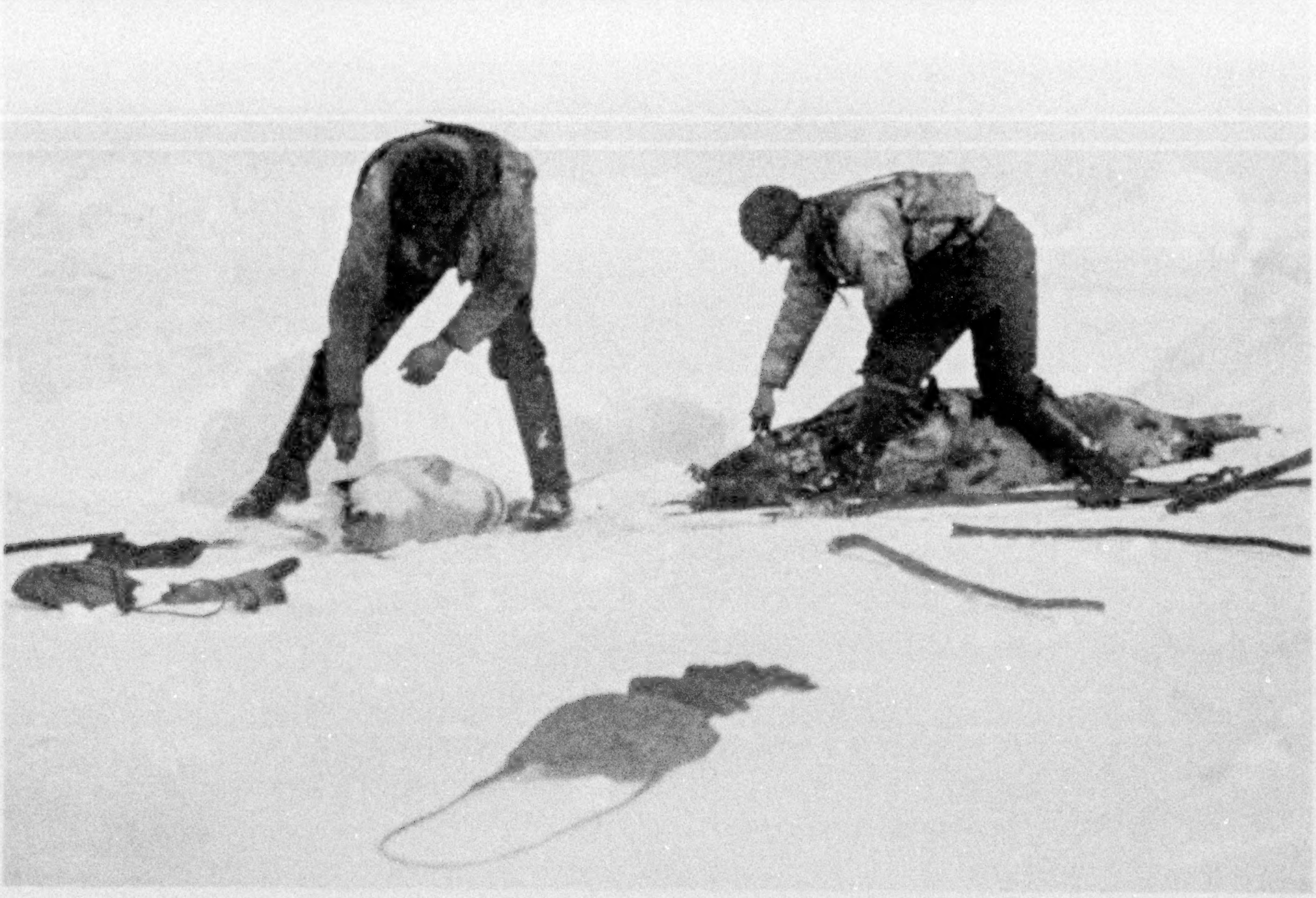
Both male and female hoods will defend the young pup. Mother hoods sometimes take their young in their flippers and escape to safety, or will nose their pups into the water, but the foolish young seals often climb back on the ice and are taken by the hunter (see page 116).



Photograph by George Harding

MAN DRAWS A RED MARK ON THE WHITE NORTH

Sealers hauling sculps to a marker leave crimson paths on the glistening white ice floes. Some Newfoundlanders contend that the seal herds, if not depleted by the annual hunt, would multiply to such an extent that they would ruin Newfoundland's fishery resources (page 119).



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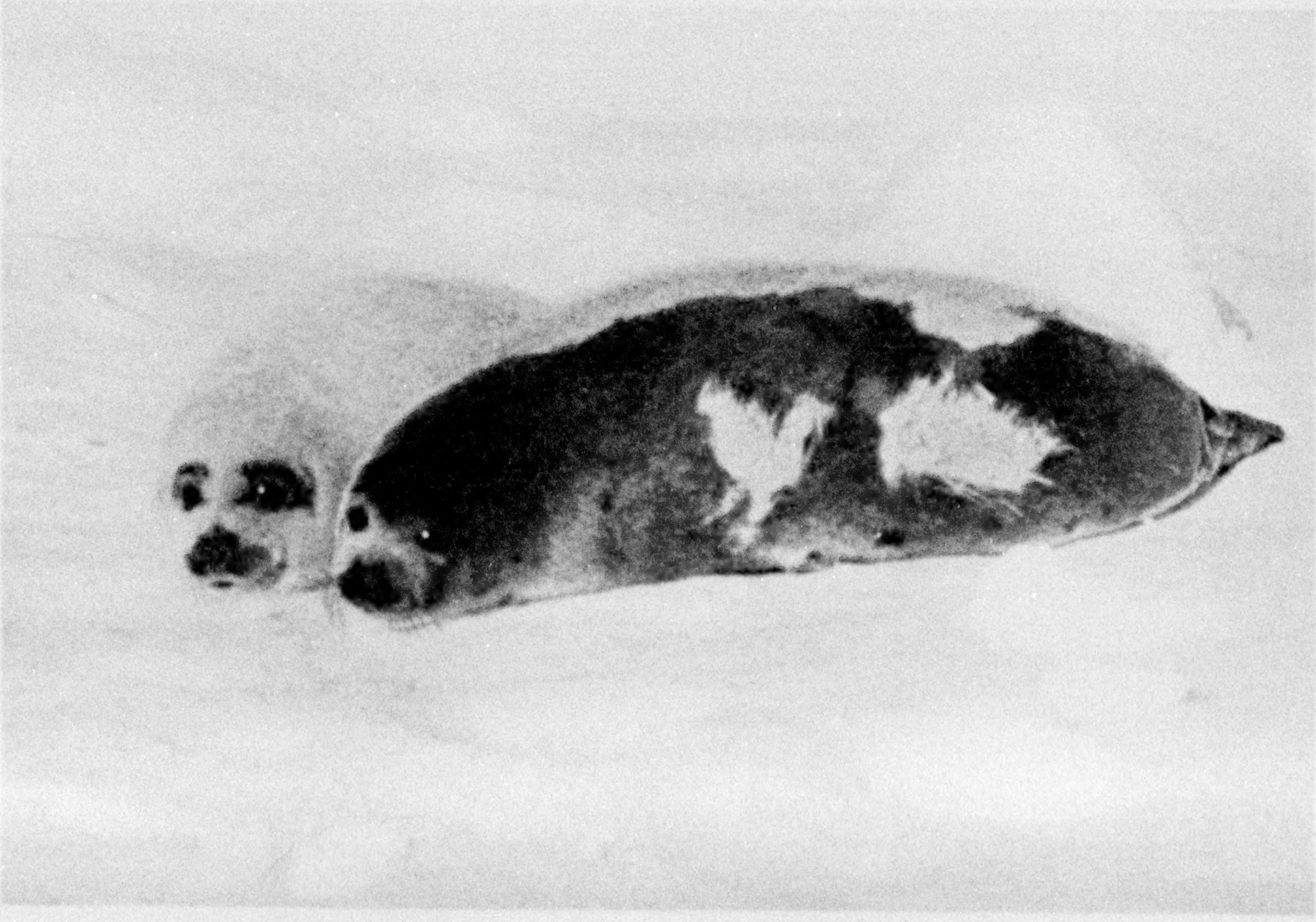
SCULPING A MOTHER AND PUP

A sealer will shuck a seal from its coat almost as neatly and easily as one peals a banana. Hunters especially prize seal hearts and flippers for supper when the hard day on the ice is done (see, also, text, page *123*).



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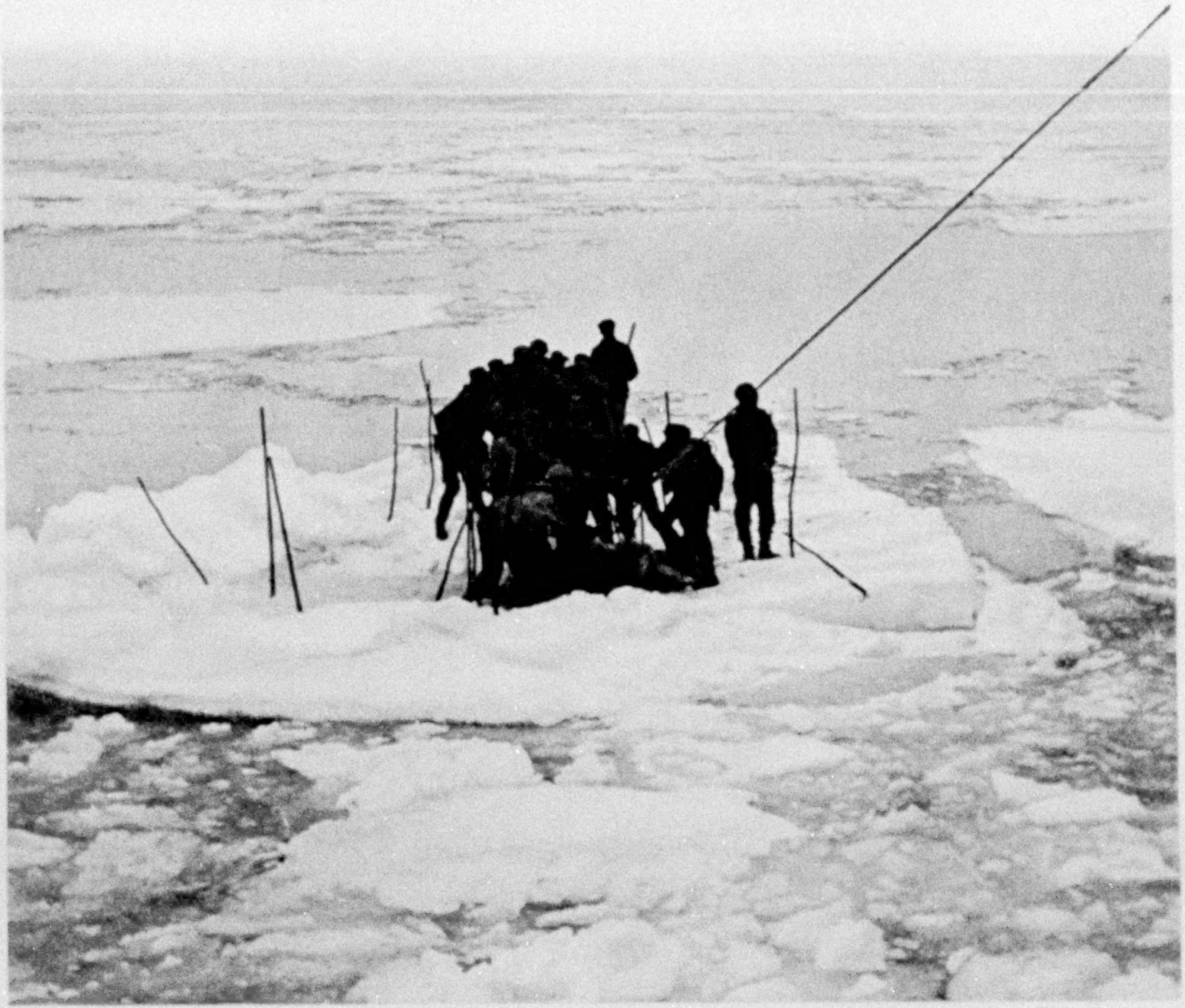
SEALERS PREFER BLONDES

The whitecoat harp is the darling of the seal hunter. He is easy to catch and sculp. The layer of fat under his gosling fuzz coat yields the best oil. When he becomes a brunette "ragged jacket" he is ready to roll in the water and swim north with the herd.



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HOISTING SEAL PELTS ABOARD

The master of each watch on the ice sets up markers (poles flying numbered flags), to which the men drag the seal pelts. A watch may collect 50 to 100 sculps at each marker. The sealing vessel steams through the ice, picking up the pelts as she comes alongside.

The hoods never mix with the harps, but they parallel them in their drift south. They whelp to the eastward of the harps several days later.

The hood is a larger seal than the harp. Its skin is spotted like a leopard's. The mother always stays with her young and will fight to the death to save it. The harp mother will run away. One has to kill the dog hood, too, in order to get the young; for when the dog comes toward the sealer he has to run unless he has a gun. I've seen dog hoods chase a skinner and carry a half-sculped young seal into the water (see page 114).

THE HOOD SEAL HAS A RUBBERLIKE HEAD COVERING

The hood's method of mounting the ice is different from a harp's during whelping season. It comes up over the edge of the ice, while the harp seal bores its way up through the ice.

The hood always whelps in families—dog, bitch, and pup. The dog hood is larger than the dog harp, is more loyal to his wife, and will help her in her wifely duties. He will hang around and help defend the family, while early in the whelping season the dog harp goes off on a vacation. The dog hood's head is protected by a loose, rubberlike cap, or "hood," from which he gets his name. When he is angry he inflates his hood, which is like a monk's cowl and protects his brain. Really, there are two caps—an outer black cap and an inner red cap. An experienced seal hunter with a stick can put him out of business, but the best way to kill the male hood is to shoot him.

Photograph from Holloway

THE "TERRA NOVA," STILL GOING STRONG

The seal fishery of Newfoundland has been a training field for crews and vessels to which Arctic and Antarctic exploration owe much. Fiala used the *Terra Nova* in Franz Josef Land; Captain Scott took her to the Antarctic.

The seal par excellence is the harp. As an adult it carries a gray-colored patch on the back, shaped like a harp, for which it is named. The harp yields more oil than the hood and the young are easy to handle. Because it gathers in close herds, less time is required in hunting it.

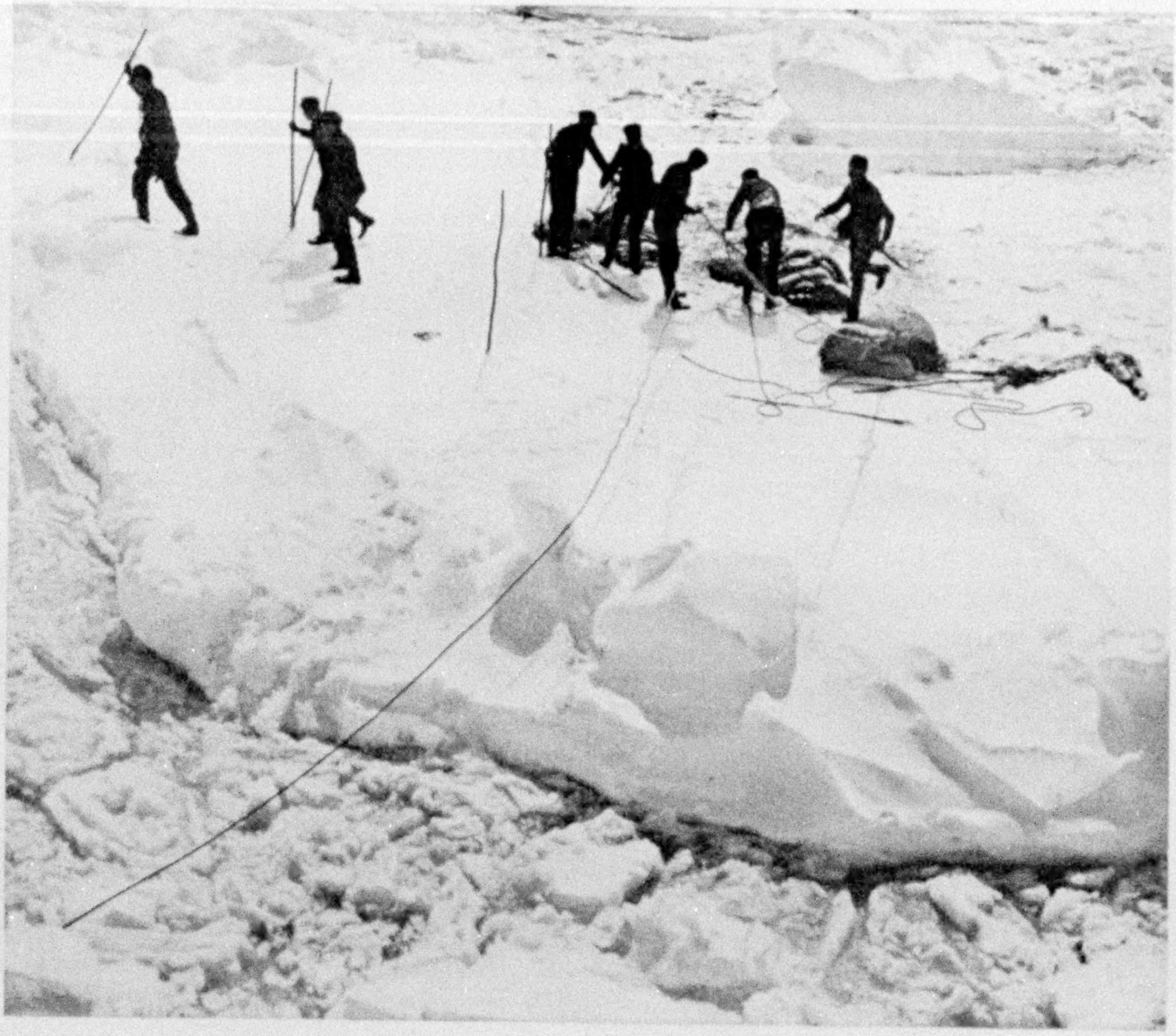
After they have been down to the Banks, the harps work northward to a vast sea eddy eastward of Belle Isle Strait, and also in to the Gulf of St. Lawrence to the west of the Magdalens. Now they are the sport of wind and weather of stormy March, and until the coming of the airplane spotter the seal skippers had nothing but their own judgment and experience to bring them to the herd.

The harp seal seeks new ice—that is, ice a few inches thick that forms in the open leads between the heavier ice. Only in new ice can the harp bore bobbing holes and get to its young, which are born on the new ice.

BABY SEALS ARE AS WOOLLY AS GOSLINGS

The baby harp looks like a fluffy white muff with two large, liquid brown eyes peering out. It is as woolly as a gosling. Later the hairs become longer and whiter, until in about 20 to 25 days the young seals roll the white coats off in their movements around the ice and become "ragged jackets." This white, woolly coat is replaced by a hair coat covered with dark spots the size of an American quarter-dollar.

In its first days the puppy seal is helpless and dependent on its mother. It



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PICKING UP A PAN OF SCULPS

One to two months of the hardest kind of work faces a man who signs on a sealing vessel. His "crop note" guarantees him an advance of $9. For four seasons, 1920 through 1923, the shares of men on the most successful ships varied from $63.88 to $74.90. Men of the *Imogene* earned most from the 1929 trip, which paid them $80.16 shares. The *Viking* had a bad time of it, earning only $9.46 per man. Therefore the *Viking's* 148 sealers got nothing except the crop for their services from March 7 to April 8 (see page 130).

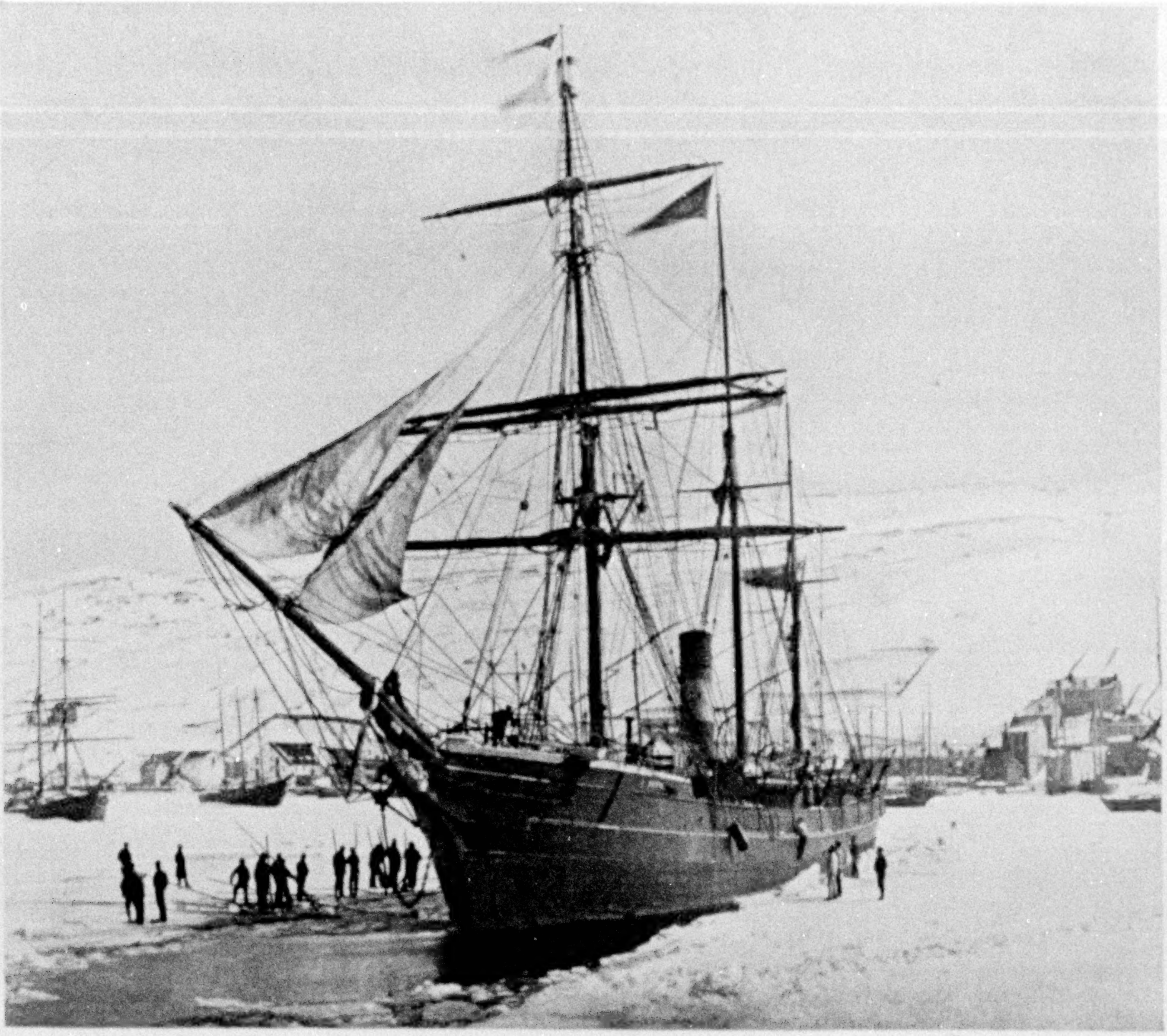
whines like a baby. The weight at birth is about seven pounds. Drinking its mother's rich milk, it puts on a pound to a pound and a half a day.

Early in the morning the mother seal leaves her puppy to seek food and to wash herself. She breaks the new ice formed in the bobbing hole and slips through into the water. At times she will swim long distances in search of food. The wind and current drift the ice along, shifting the floes to and fro, around and about; and yet she will always return to the hole that she has left and always find her offspring!

I have moved the young whitecoats around, changing the places in a group of 30 or 40. When the old one comes, she will nose this one and that one until she finds her own.

When a young seal first strikes the water he backs out. He is afraid of it. He looks and looks at it, but at last he decides the water is his real home and he rolls in.

Evidently the migration of the hoods and harps has been going on for centuries. Each year for a hundred years the hunters of Newfoundland have sought the herds soon after whelping time. Not only the young, but also the old seals, the bedlamers (a corruption of the French *bête de la mer*), two to three years old, are hunted. But still they come. About 150,000 seals



Photograph by S. H. Parsons and Sons

VETERAN AND VICTIM OF THE ICE

The *Proteus*, which hung up sealing records, took General Greely north to Lady Franklin Bay in 1881. Later, sailing to the relief of the party, she was sunk in the ice off Cape Sabine.

whelp in the Gulf of St. Lawrence and about 300,000 off the Atlantic coast of Newfoundland.

THE SEAL CATCH NOW IS LESS THAN ONE-THIRD ITS FORMER VOLUME

At one time probably half a million seals bred annually. To-day the herd has been reduced by half. There is a great difference of opinion among Newfoundland sealing men as to whether the seals are becoming scarcer, but it is a matter of record that in late years the annual catch has been in the neighborhood of 200,000 sculps, in contrast with earlier years when the catch ran to 700,000.

Some people wonder about the killing of all these seals for the sake of their oil and skins, but when one takes into account the number of fish the large herds destroy, the seal fishery is a great boon to Newfoundland. It has been estimated that when the seal herd gets on the Banks it consumes three million pounds of cod per day. I have cut the seals open myself and have found their stomachs filled with capelin, herring, and small cod, which swarm in the Gulf of St. Lawrence in great numbers.

As I was saying, sealing is a hard life. Men on board a sealer are jammed in as tight as sardines in a box, particularly in the smaller wooden vessels. Going out, every available bit of space is filled with coal, with ice-fighting equipment, sealers' chests, dunnage bags and sealing gear, and men as thick as flies around a molasses puncheon. If we are lucky to get

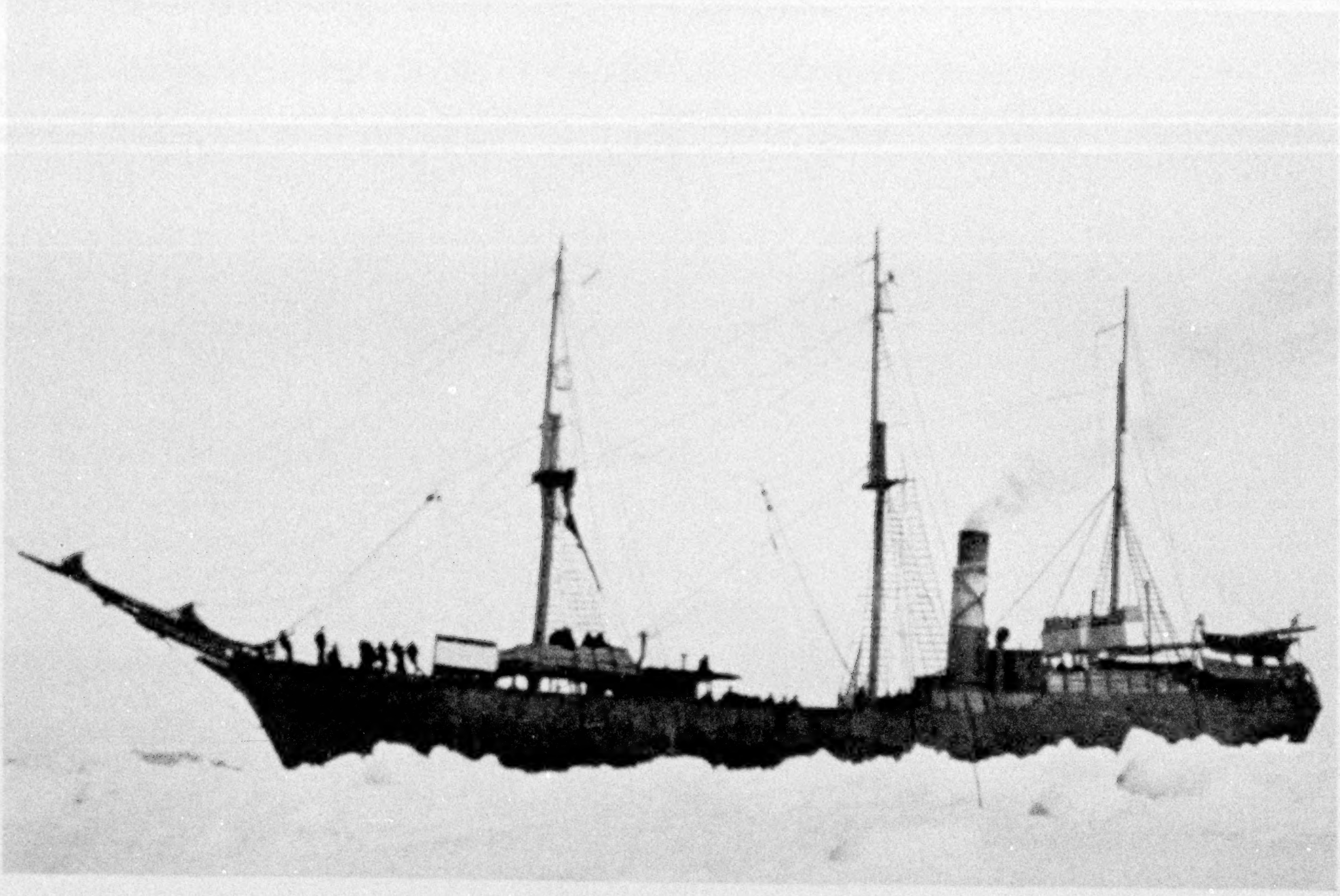
SEALERS, INSTEAD OF HORSES, RACE IN NEWFOUNDLAND'S SEAGOING DERBY

The islanders hazard thousands of dollars annually on the sealing sweepstakes. Wagers are made on the first vessel in, the hour of arrival, date, and number of sculps aboard. The man, woman, or child who draws the first vessel in port with a load gets the biggest prize.

Photographs by George Harding

BUCKING "SLOB"

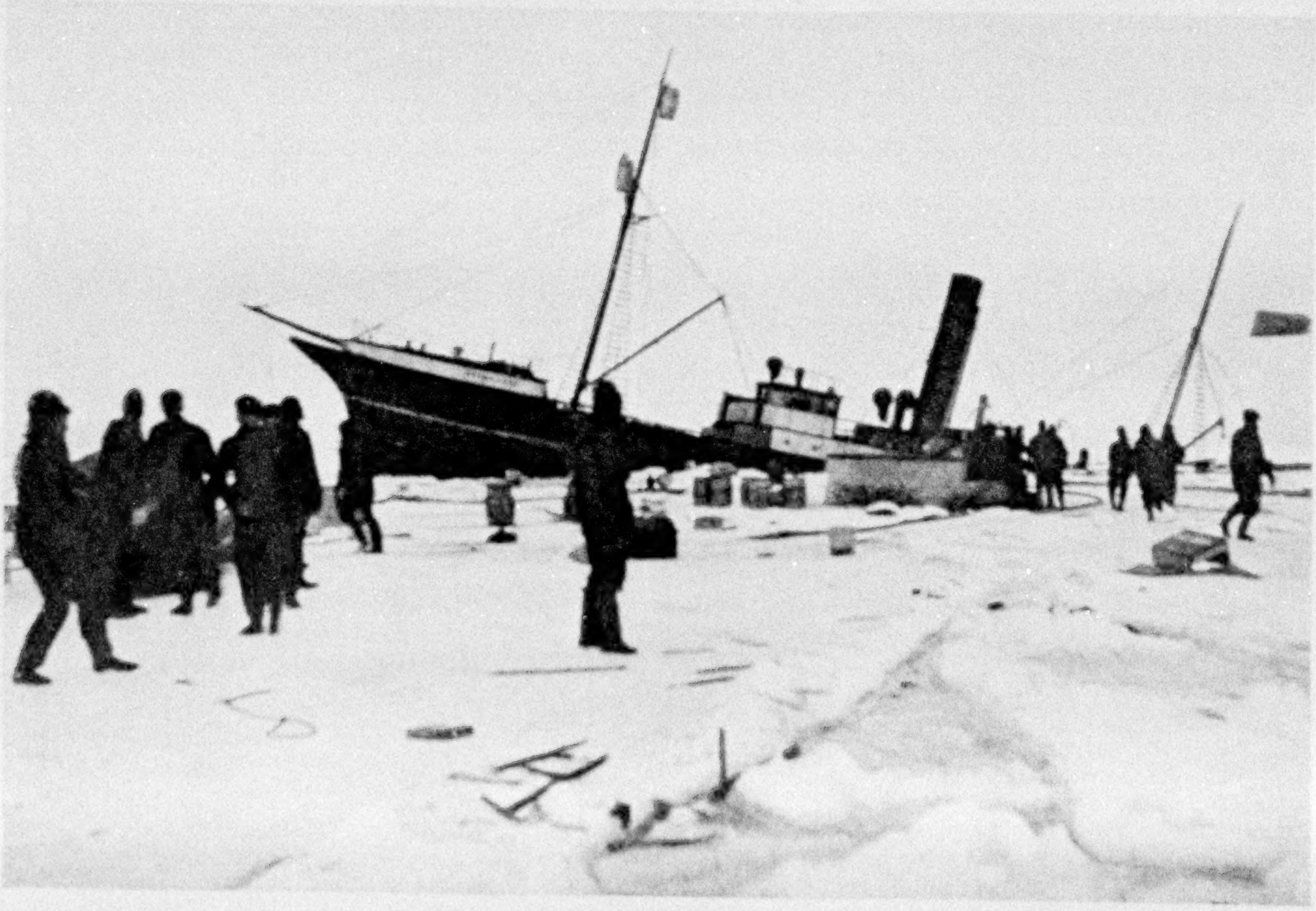
If the ice is early coming down the St. Lawrence, it is heavy in the gulf—five to eight feet thick. Some places it rafts up 50 feet high and looks like polar basin ice. At other times it is so level one could skate for miles and miles or run an automobile on it. Again, it is tumbled about as if an earthquake had struck it.



Photograph by Capt. Robert A. Bartlett

"STARBURD! STEEEAY! PORT! STEEEAY!"

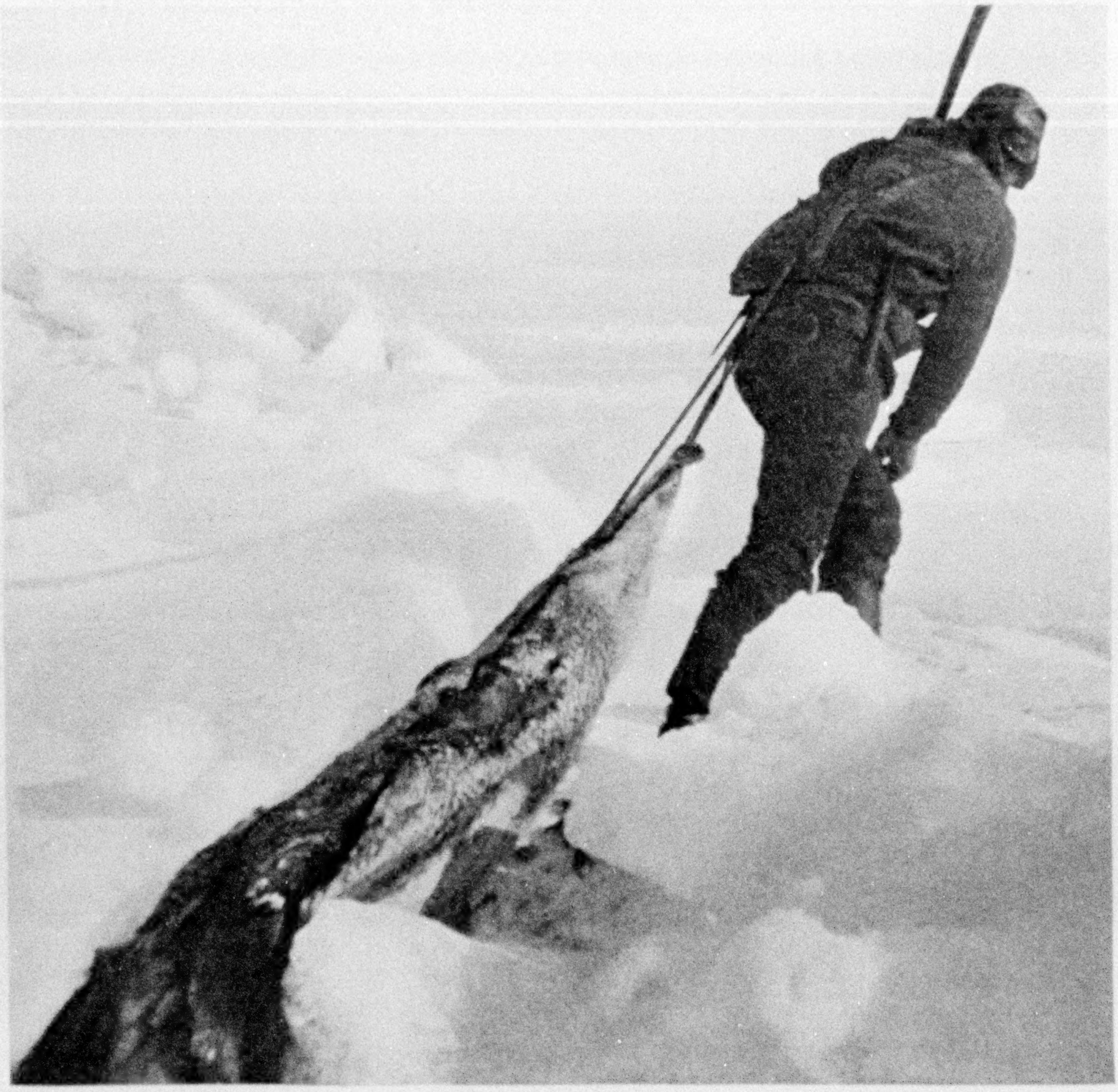
The *Viking,* skippered between 1904 and 1923 by Capt. William Bartlett, father of the author, fights the ice. Fridtjof Nansen, the Norwegian Arctic explorer, made his first trip north in the *Viking.*



Photograph by George Harding

NIPPED AND SUNK WITH 19,600 PELTS

The *Grand Lake,* pride of the seal fishery, was lost with a load of skins, on her sixth annual trip. Her crew of 203 men escaped over the ice to the *Vanguard.* Nature, as if to compensate seals for lack of means of defense, has given them a home guaranteed to discourage their enemies, both wild and civilized.



Photograph by George Harding

"SCOTIN' HIS TOW" OF FAT

A young author in sound health, who went out one year to the seal fishery, put his shoulder to sculp-hauling through snow, over ice rafters and across leads. He lasted half an hour; sealers keep at it all day. A sculp is the skin of the seal with the layer of fat adhering to it. Whitecoat sculps average about 37 pounds in weight.

a quick pick-up, many of the men are "burned out" by a big cargo of sealskins, which takes up their bunk space, and they've got to double up in already crowded quarters.

There is some relief in the watches, when one man is out and another man can use his berth.

THE SEALER IS "FINICKY" ABOUT HIS FOOD

A sealer carries provisions for two months and a half—70 to 80 barrels of potatoes, 100 quintals of codfish, 80 barrels of flour, 35 barrels of pork, many pounds of tea, molasses to sweeten the tea, butter, turnips, and beans.

Could some of the old sealing crews take a look at what's going on now, they would be shell-shocked with wonder. They'd think the fishery was ruined on account of luxurious living. They had nothing but hard biscuit and tea, pork and duff, with little grease in the duff. No soft bread whatever.

On ship we have what we call Solomon Goss's birthday. He has a birthday three times a week — Sunday, Tuesday, and Thursday. On these days for the noon meal we get duff. For duff, flour (a barrel or more to a batch) is stirred with water, currants, and molasses. With a blade as large as a canoe paddle, the cook mixes it into a paste; then he adds shortening—fat from boiled pork.

The dough is packed into canvas bags. These bags are two-men-duff size or three-men-duff size. The cook puts all the bags in a big boiler on the galley range and boils them for two to three hours. Another boiler alongside contains pork. When the duffs and pork are ready the cook calls the roll, and one man of each three messmates comes to the galley and gets the allotted share of pork and duff for himself and the other two men, waiting for him below in the quarters.

As the men come by, the cooks stab the duffs with miniature pitchforks, lift them out of the boiler and douse them in iced water. Then they deftly skin the bags off the duffs, which fall into the men's pans.

There are no tables or messboys to wait on the men.

On Sunday morning the crew gets "brose"—boiled bread and codfish with pork gravy spread over it. Butter, fresh beef, salt fish, potatoes, and turnips are whacked out to the men at different times, and they can prepare a meal for themselves any time they want to, except on Solomon Goss's birthdays, when the range is filled up with boilers.

Tea is made in big kettles, five gallons at a time. On duff days the men make their own tea with tea leaves the cook gives them or that they have bought with their crop money.

The afterguards have it better. The chief engineer, "Marconi" (radio man), second hand, barrelman, and doctor dine with the captain, while the officers dine in the mess room. The galley forward is not used by the afterguards at all.

YOUNG SEAL FRIED WITH ONIONS IS A FAVORITE DISH

When we get among the young seals we boil or fry the seal meat. A mess crowd will cook a bit of seal with onions and butter for themselves. It is good; sometimes, it seems to me, much better grub than the afterguard gets.

The men cook everything about a seal—livers, lungs, hearts, brains, flippers, and body meat. Seal tastes like mutton—very good! Personally, I would rather have seal meat, cooked the way sealers cook it, than the best porterhouse steak; and in the North it prevents scurvy.

As a rule, we leave one flipper in a pelt. Some skippers make their men cut out the flippers. With 30,000 or 40,000 young seal sculps, the weight of this flipper would be 25 tons, I suppose. We have our Harry Lauders in our Newfoundland seal hunts. But among the men, on the whole, they like to bring in the flippers and peddle them around St. Johns, where they get 25 to 50 cents a dozen for a string.

Some of the sealers have rich friends, who stage flipper parties in the swagger clubs of St. Johns. For this purpose the sealer ices down flippers, which may taste a little bit better than the others. A flipper party is a great event, as great as an ambassadorial function in Washington. Social debts are paid with a bridge and a flipper supper, washed down with French and Portuguese wines.

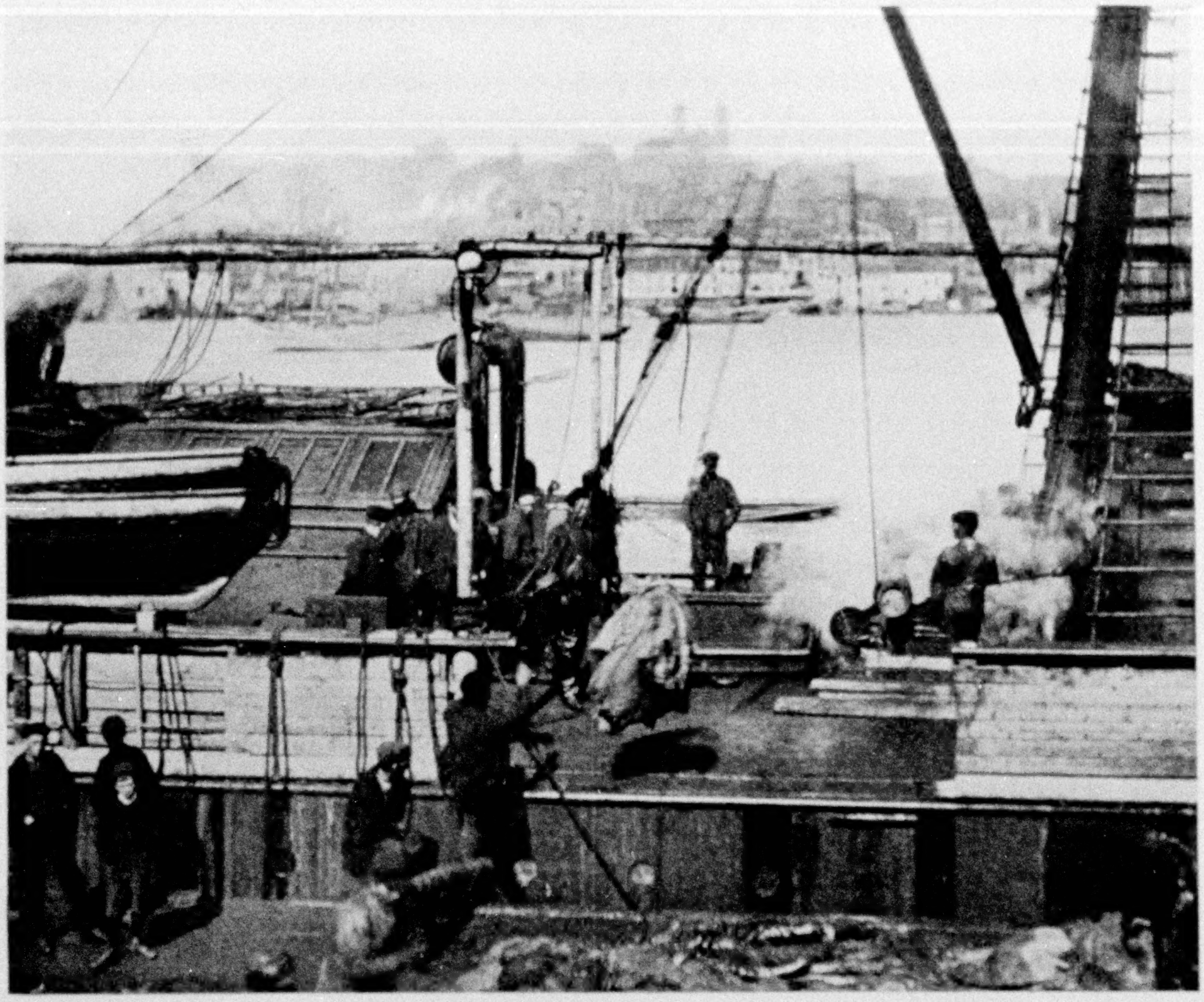
AN INGENIOUS METHOD OF OBTAINING FRESH WATER AT SEA

Now, about the fresh-water proposition. If a vessel were a tank itself, it couldn't hold enough water for all hands and the steam boilers. What do we do for fresh water? When we leave port a couple of thousand gallons are in our tanks. We don't use that. Just as soon as we get into the ice, we use pinnacles. These pinnacles are formed by the rafted ice (see page 108).

The crew cuts this pinnacle ice and dumps it into a steel tank on deck, to which a pipe runs from the engine room, bringing live steam that melts the ice. The water has a tallowy taste, but we drink it all the same. What the eye doesn't see, the heart doesn't feel.

Early in the season it is very hard to get fresh water when out on the ice. Only when it rains or the sun is warm do drinkable pools form. So the sealer has either to bring water in a canister or eat an orange. He can't suck an icicle, because on a frosty day it will freeze to the lips and tear the skin. Anyway, it is not satisfying.

In Newfoundland we have mountain ash, and from the young saplings we cut



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HARVEST OF THE ICE AT ST. JOHNS

Prices for pelts vary from $4 to $12 per 100 pounds for young seals; $3 to $9.50 for old seals. Whitecoat pelts average 37 pounds; skins of bedlamers and old seals weigh between 45 and 200 pounds. During the 1929 season 3,709 tons of sealskins were taken, and were sold for $364,351.59.

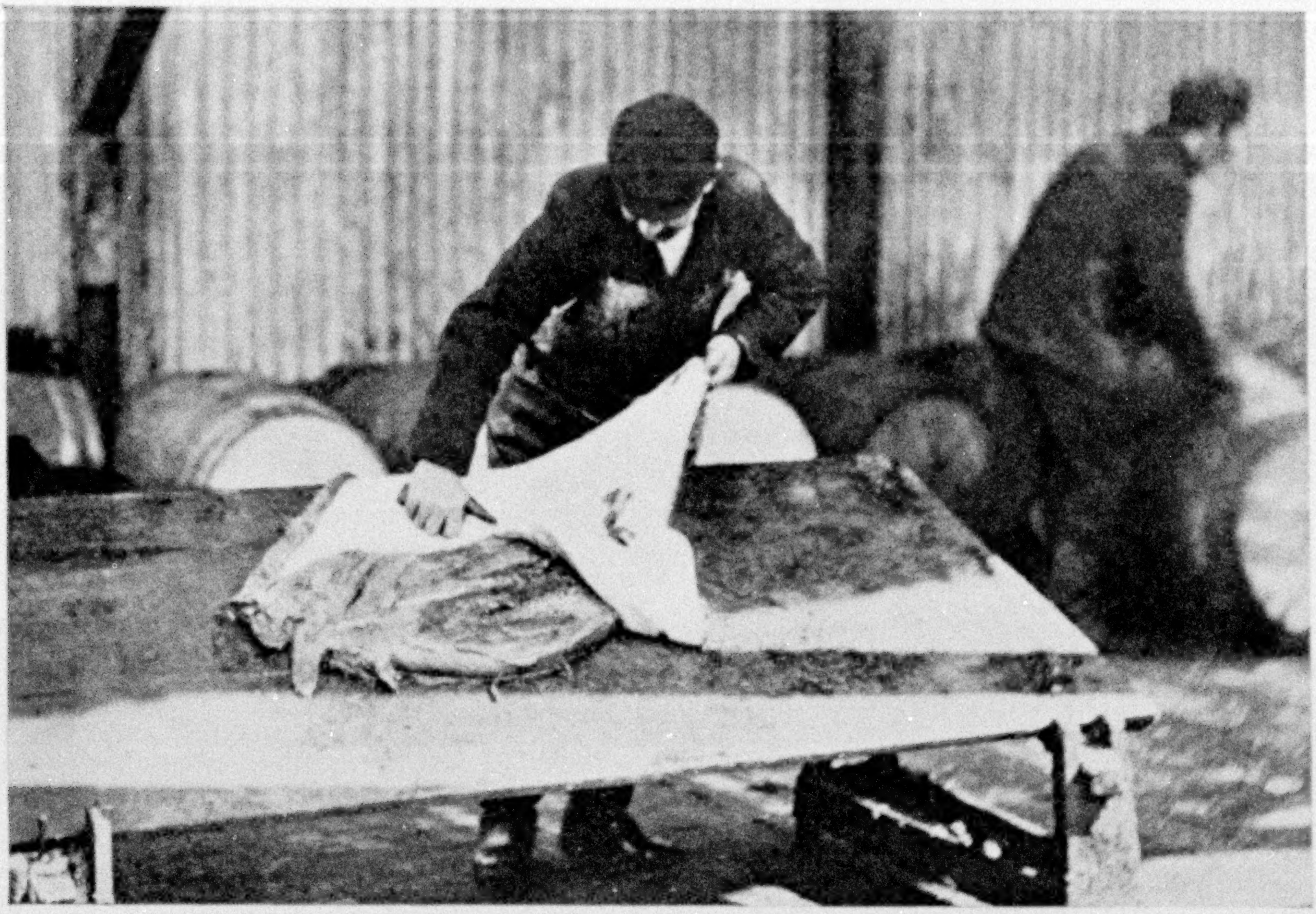
the bats or clubs which are the sealer's chief implements. They are small, tough, and easy to handle, about seven feet long and about half the diameter of a man's wrist. We call them dogwood bats. A groove is cut in the end, into which slips an iron gaff with a hook and a start (spike). With his bat the sealer clubs his seals, and with its aid he vaults from pan to pan or poles the ice; and he can use the hook to pull a seal or a man out of the water. A bat is part of the sealer. We laugh at a man who would leave the ship without his gaff or bat. That betrays a greenhorn right away.

The sealer also carries a rope over his shoulder, Sam Browne-belt fashion, an 18-thread ratline, four fathoms long, and in the end of it is spliced an eye. The other end is pointed with sail twine to make it stiff, so that it can be threaded through the lace-holes at the edge of the seal pelts to lace them up (see page 101).

A knife and sheath and a steel with which to sharpen this knife are part of every man's equipment. He has goggles, a compass, a watch, and a water canister. On his feet he wears tanned sealskin boots soled with leather and calked with steel chisels, three in each heel, and heavy sparables, or nails, in the soles. The steel chisels are about an inch long and keep the wearer from slipping on the ice.

A SKILLFUL WORKER CAN SKIN A SEAL IN A MINUTE

Each man has strapped to his back a small canvas "nunny" bag, in which he carries an orange or two to quench his thirst, some raw oatmeal mixed with sugar,



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SKINNING A SCULP AT ST. JOHNS, NEWFOUNDLAND

After the pelts are brought ashore they are fleshed—that is, pieces of meat which adhere to the fat and which would discolor the oil are cut off. This is called the tare. Then the layer of fat is cut from the skin. Nowadays the latter process is performed by machines.

a few hard biscuits, and a piece of seal or pork left over from a previous meal. This is his grub for a day on the ice.

The men go overboard in gangs, or watch crews, 40 to 50 men in a watch. The master watch is responsible for the working of the men and their safety. Each crew tries to beat the other crew, and each man tries to beat the other man. Where the seals are fairly plentiful, the master watch raises a marker flag and leaves some men, and then another flag and more men.

The mother harp goes down a bobbing hole as the sealer approaches. Young seals are saucy and will come for a man until he snogs them with his bat. He turns the dead whitecoat on its back and slits it down the belly. Then he carefully cuts the body away from the pelt, which is the skin with the white fat fastened to it, and then cuts off the hinder daddles (back flippers). One or both front flippers may be removed (see page 123).

The sealer must be quick and he must be careful. Every hole in a sculp or skin costs a man ten cents. A skillful worker can skin a seal in a minute; some have done it in 40 seconds. A sealer who can kill, skin, and pan—that is, haul the pelts to a marker—120 in a day is a good hand. Men have been known to do 300 in a day.

A CAREFUL COUNT IS KEPT OF ALL SKINS TAKEN

As soon as a man has got his tow killed, three to six pelts, depending on his strength and the ice conditions, he laces them up and bundles them together. If the ice is frosty, it is hard to drag the skins along, because the hair sticks to the ice; but if there is water or snow on the ice, the pelts slip along easily. Suppose he comes to a lead; he gets the skins to the edge and throws the rope across as far as it will go. Then he jumps across himself and hooks the gaff into the eye of the rope and pulls them across. If the seals are thick, there may be anywhere from 50 to 100 sculps on a pan waiting to be picked up by the ship. It is all a rush.

© Holloway

SEALERS IN "GO ASHORE" RIG

Along about the last of March, if we haven't been fortunate enough to get a trip of young seals, we begin to look for the old ones. We follow along north after the herds. The seals are now very wild and we must shoot them with rifles.

No skin is put down the hold warm; it would spoil. The master watch stands at the hatch with a tally stick. Hands are bundling the sculps into the hold.

"One, two, three, four," they shout one after the other.

"Eighteen, nineteen, twenty."

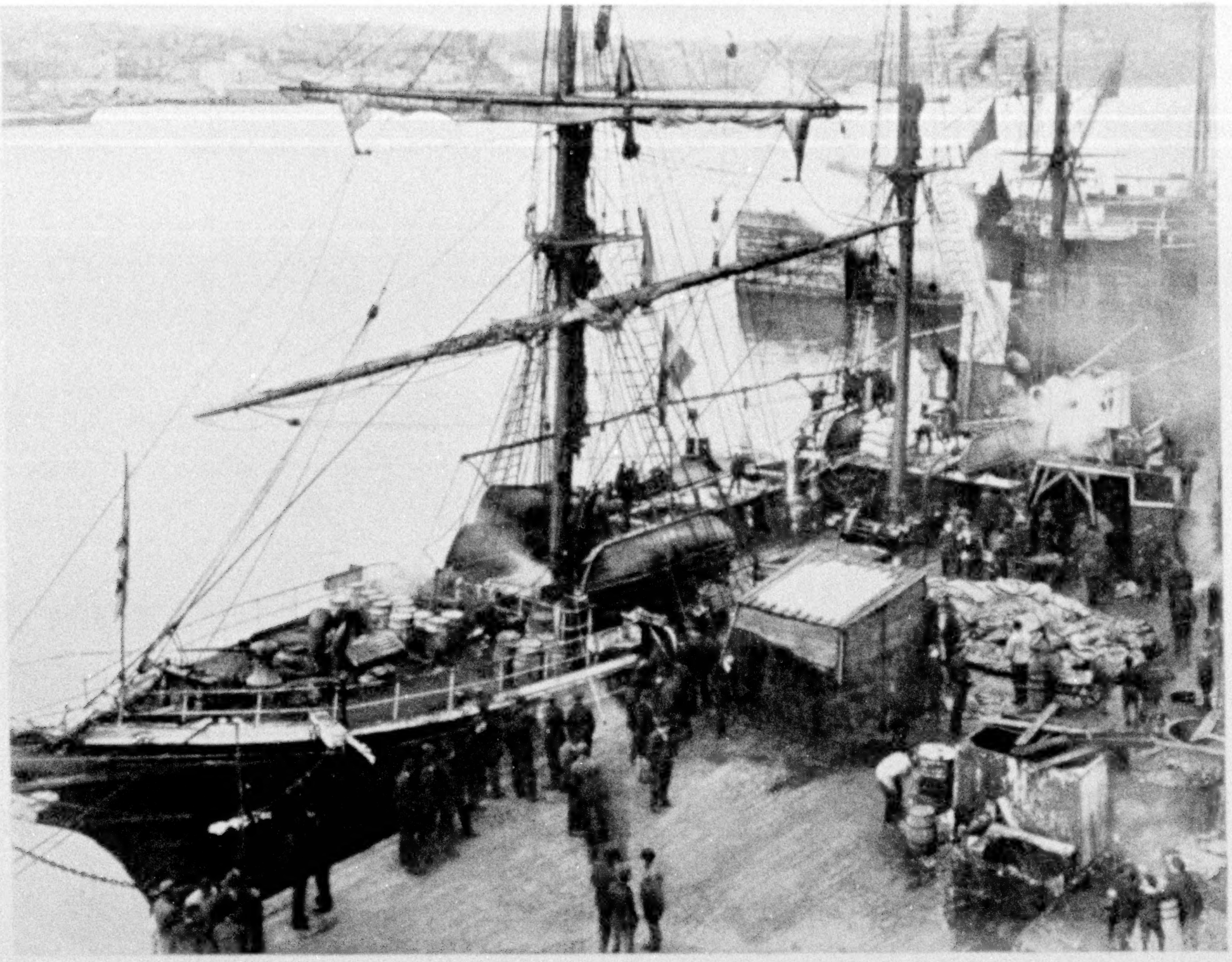
"Score," yells the master watch, as he notches the tally stick with his knife.

"Heave down one for the rats," he yells.

Down goes another sculp. To every twenty pelts one extra skin is added, but not counted. A skipper wants to be sure he's living up to his report to the owners. The tally sticks are turned in to the captain, who, at the end of the day, puts down in his book what is stowed below.

THE OLD WOODEN SAILING SHIP DISAPPEARS FROM THE SEAL FLEET

In the days when sealing was carried on in sailing vessels, there were always ten or a dozen boys aboard. The idea was to break them in young. The old captains always had the future welfare of their ships and crews in mind. These ships, being square-rigged and propelled through ice and water by sails, and then, in calms, by tracking and poking and prizing, needed men who knew their business from ice to truck and stem to stern—all the evolutions and sail management, the working of canvas and dragging of ropes. Day or night, blow high or blow low, there was no let-up, for those were the days of iron men and wooden ships. Boys trained in this school knew nothing else.



Photograph from Holloway

THE "AURORA" UNLOADS SEALSKINS AT ST. JOHNS

The camera could not record the odor. Keep to the leeward of a sealing vessel, is good advice. Yet, by the sealers' standards, the "fat" is fresh. Men pack layers of skins with "salt" (blocks of sea ice) and no skin is put in the hold warm, because a single putrefying pelt can spoil a cargo.

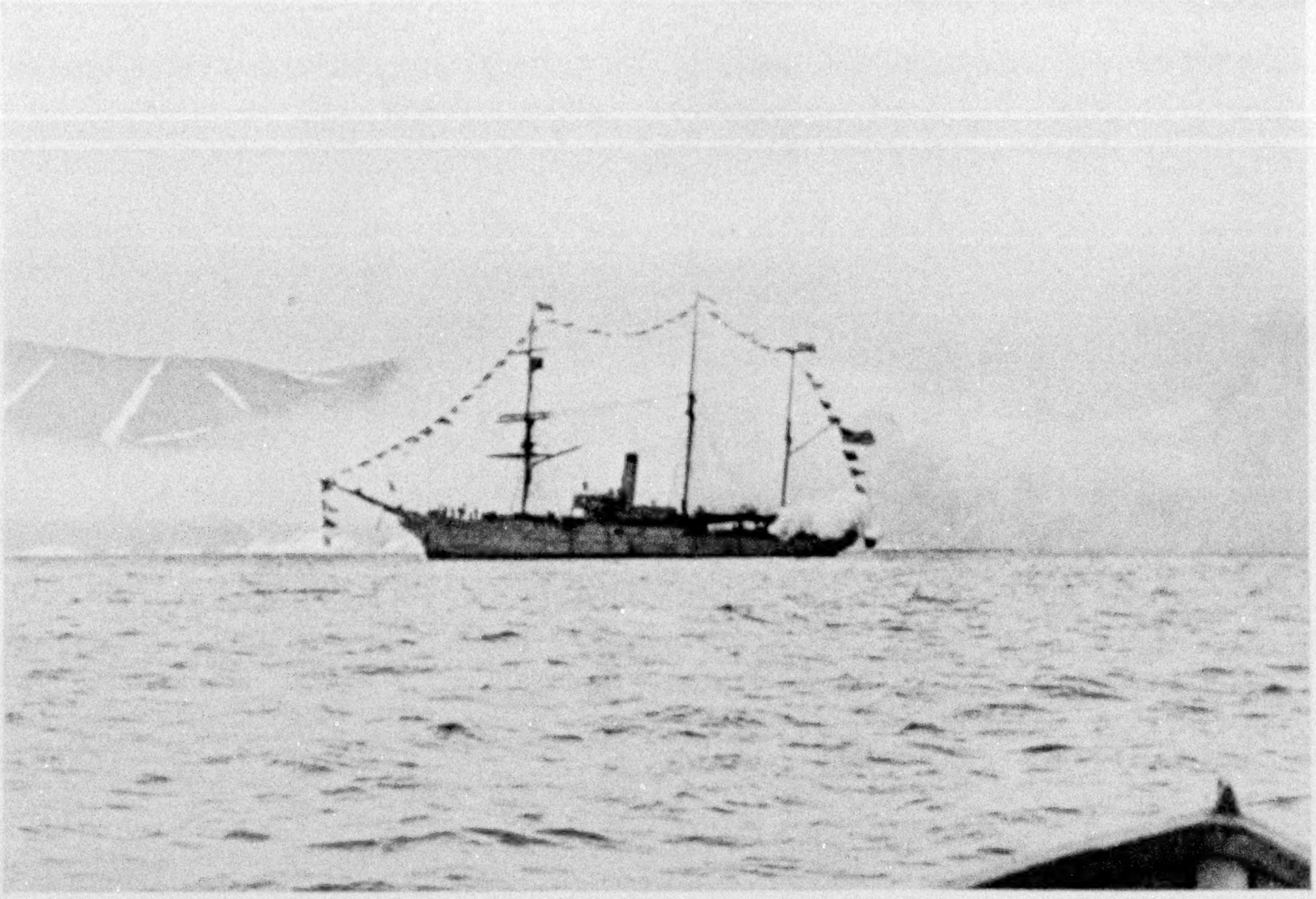
When a boy was 17 years old he could handle a ship as well as a boy can handle a catboat in Long Island Sound to-day.

Nowadays, with all the machinery in vessels, a boy hasn't a chance. A skipper is no more than a conductor aboard a vessel. The captains of steel vessels want the very best seasoned men available. Except for the few wooden ships remaining, the greenhorns of Newfoundland would be out of luck.

Therefore, the only way young boys can get to know vessels is to stow away. This is what they do. I was making a trip myself, and when the ship was searched before pulling away from the dock we found two boys, 10 or 12 years old, stowed away in a bread box on deck. We had to put them ashore. Other boys were luckier.

In the days before wireless there was no communication. When the boys succeeded in stowing away, they were carried along, and their relatives didn't know whether they had been drowned or what had happened to them. Now the radio reports the names of all boys who succeed in stowing away on sealers. On some of the vessels last year there were as high as twelve boys stowed away.

There are many hardships to sealing, and one of them is the danger of ice blindness. Landsmen call it snow blindness, but we call it ice blindness. It may seem a strange thing to say that, notwithstanding the bitter lessons that the sealer experiences from time to time, he still gets ice blind. Although he carries goggles, somehow or other—it may be carelessness or indifference on his part—he fails to wear them. The result is that after being on the ice two or three days half of a crew



Photograph courtesy Captain Cochran

THE "BEAR," AN ANGEL OF MERCY IN THE BERING SEA

Purchased by the United States Government from her Newfoundland owners, this old sealer served many years in Alaskan waters. Peary engaged various Newfoundland sealing vessels for exploration after the hunt was over, among them being the *Kite*, the *Falcon*, the *Diana*, the *Eagle*, and the *Erik*. On June 22, 1884, the *Bear* and *Thetis*, which had gone north with Newfoundland ice pilots, rescued the Greely party.

may be out of commission. We lecture them, swear at them, tell them we will stop their shares unless they wear goggles; but you can't make them.

It is a serious thing; it is a terrible sensation. I don't know of anything worse. I have been blind myself in the North. It is like having sand thrown in the eyeballs. Water runs out of the eyes. With a good dose of it, men have almost become insane.

My recipe is to wear goggles day and night; then you get used to them. The trouble is men raise the glasses to wipe the sweat out of their eyes and forget to pull them down again. Then, before they realize they are in danger, they are blind.

GETTING LOST IN FOG OR ON ICE FIELDS IS A GRAVE PERIL

Then, again, there is the danger of falling in the water when a long distance from the ship. Here is a sealer who has slipped into the water. He has "gone down till his cap floated" and he is soaking wet. His "buddy" has fished him out with a gaff. A gale of wind is blowing—freezing weather and no shelter. But he has to get those wet clothes off or have them freeze on him as stiff as the pillar of Lot's wife. The two seek the biggest pinnacle, and in the lee of it the wet man strips off his clothes. His buddy lends him all the clothes he can spare, while they wring out the wet ones. It is a terrible job. I have been through it, so I know. It is an awful task to haul the clothes on, but it has got to be done.

The chance of losing his men on the ice in a fog or blizzard is a worry that always besets a captain. It must be remembered that this work goes on at the worst time of the year, when gales of wind and snow are the usual thing. Before the time of radio and the reports of well-equipped weather bureaus at Washington and Toronto, the only intimation of bad weather was from a skipper's "horse sense" and the barometer. A good skipper can smell weather; you can't fool him.

THE SKIPPER OF A SEAL SHIP SHOULDERS MANY RESPONSIBILITIES

Every morning a skipper must decide whether to put his men on the ice or not. At times he is torn between anxiety for his family men and the profits for his owner.

He orders the men overboard, let us say. Away they go. The skipper often wonders to himself if they will all turn up. In 1914 the fleet was all together on the front. The weather was threatening, but some captains put their men overboard, hoping that the day would end fine. But out of the northwest came a terrific blizzard. Wind and snow jammed the ships, so that they could not get to their men. Lakes of water opened between the men and the vessels. In the raging storm many men fell through the cracks and froze. When the weather cleared next day the steamship *Newfoundland* had lost 77 men!

On another trip we were in the gulf, on the *Hope*. Father left instructions that he be called at dawn. I was up before dawn and it was wild then. About 8 o'clock the weather came. Fortunately, we had not put anyone out. The vessel lay over on her side. A man could hardly stand on the ice. The *Hope* was all right, but the steamship *Greenland*, on the other side of the island, had put all her men out, and during the storm 48 perished. Scarcely a year went by but one or two ships were lost. The building of steel vessels and the use of wireless to receive weather reports have cut down losses in recent years.

SOMETIMES A SHIP ANCHORS TO AN ICEBERG

There is much danger of a ship being crushed by the ice pans swinging together and rafting the ice against the ship's sides—nipping her, we call it. Then there is danger of being driven on an iceberg. At this season of the year icebergs are on the sealing ground.

Of course, they may be a godsend. If a skipper, with his ship jammed in the moving floe, drives close to a grounded berg he can sometimes free himself and come up in its wake and make a line fast. Anchored to the iceberg, he may be lucky enough to have the seal herd drive along by him, borne by the current and winds.

Some ships are nipped; others are caught in the ice and are drifted helpless on reefs. The *Huntsman* was one of several vessels caught in a northeast gale off the Labrador coast. The ice carried her and some of the other ships inshore. Crews of the other ships got safely ashore and reached Battle Harbor; but the *Huntsman* drove over a reef and ripped her bottom out. On this reef a rock stuck out at high water.

The men at Battle Harbor went on the hill next day for a look. They were amazed to see something moving on Fish Rock, about three miles away. They went out in a boat and found Solomon French, the solitary survivor of the crew of the *Huntsman*. He had been hanging to the rock for 30 hours. Both of his legs were broken. It is unbelievable, it is uncanny, nothing short of a miracle, that he hung there, continuously battered by ice. One of the men set his legs and he afterward went sealing with father in the *Panther*.

IN THE GRAVEYARD OF THE ATLANTIC

Newfoundland's seal fisheries have few sadder tales to tell than that of the *Southern Cross*. After making a quick pick-up of seals, the *Southern Cross* was almost home. Ten hours more and her crew and cargo would have been safe in St. Johns. Off Cape Pine, early in the morning, she was caught in a gale and sank with 174 men. Except for one life belt picked up on the coast of Scotland some months afterward, not even a stray bit of wreckage was ever found.

When master of the *Leopard*, I once had a very narrow shave. When only a few hours out of St. Johns, bound for the gulf, I struck a heavy easterly gale and ran to the ice for shelter. I was afraid I would lose my deckload of coal and equipment if I stayed in the water. Before I could get around Cape Race, I struck on Black Head, a graveyard of the Atlantic, at 2 o'clock in the morning.

The *Leopard* carried about 103 men. There was a good swell in the ice and it was so pounded up that we couldn't walk ashore on it. It was so deep that it was like quicksand—bottomless. A step in it and we would sink to our shoulders.

We had to rip up the deck sheathing, and by using these boards and oars we made a road over the ice to shore, which was only a cable's length away. When I left the vessel her bridge was in the water. By the time we got ashore the sea hove in, and when dawn broke there was nothing to be seen of the *Leopard* except some wreckage along the cliffs.

HOWEVER GRAVE THE RISK, OFTEN A CREW'S PROFITS ARE SMALL

What do the men get out of all this hard work? The vessel may make a quick pick-up and be through in a few days; again, vessels have been out for two months and returned without a seal. The only guarantee a sealer gets is food and a crop note, equivalent to $9. He works on shares. One-third of the net earnings is divided among the crew. That includes everybody except the captain, who gets four per cent. He takes the same risk as the crew—no seals, no money.

Shares have run as high as $238, but the average is about $60. This is not much, but it comes at a time of the year when a little money looks good. The Newfoundland fisherman is a pretty independent individual. He owns his own home—every nail in it. Usually he has money in the bank. He has a horse, a cow, and a boat. He raises his own potatoes and turnips, catches his own fish. Each family has a sheep or two and the women spin and weave their own wool. If the share of the sealing trip covers the family's few needs, then what they get in the cod fishery or mines during the summer is profit.

On the arrival of a vessel with a trip of seals, the sculps are landed by the crew. Pelts are weighed in scales. They are spread on the dock, but the scent rising from them makes St. Johns no bed of roses. You can smell a sealer almost as far as you can see him. But, after all, the money is clean.

Crowds of boys get the job of fleshing seals—that is, taking off bits of meat that still adhere to the pelt. Meat would discolor the oil (see page 125).

There's usually a pound to a pound and a half of meat and hair to a whitecoat sculp. This is called tare. On old seals the tare runs anywhere up to seven pounds.

SKILL IN TREATING SEALSKINS

An escalator carries the pelts to a skinning loft, where a mechanical skinning knife does the work of many men and does it more efficiently. It shaves the fat from the skin better than a skinner could do it. The fat goes into a grinder, where live steam disintegrates it, and eventually it is reduced to a fluid state. Finally it goes to big steel vats holding many thousands of gallons. Over the tanks are mounted hothouse glass frames, and the sun shining on the oil clarifies it. This oil is pumped into tankers and brought to Newark, New Jersey, where it becomes a constituent of soap.

The sealskins are tanned and used for various kinds of leather goods. The next time you enter a leather-goods store to buy a pinseal pocketbook, hold the article in your hand and think of its story. Think of the seals tossing on the ice pans off the coast of Newfoundland amid wind and hurricane weather. Think of the hardy men who go down to sea and risk their lives walking on the ocean to take the pelts. Think of the strong Newfoundland ice vessels that bring them home in order to supply the world with pinseal novelties and purses for its valuables.

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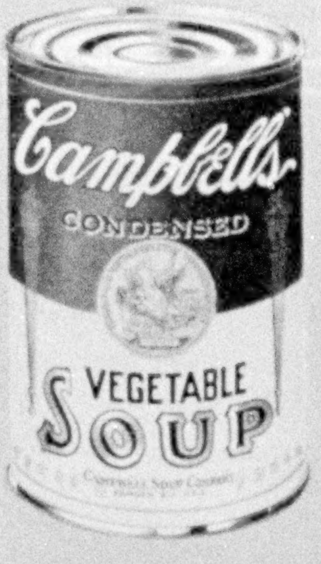

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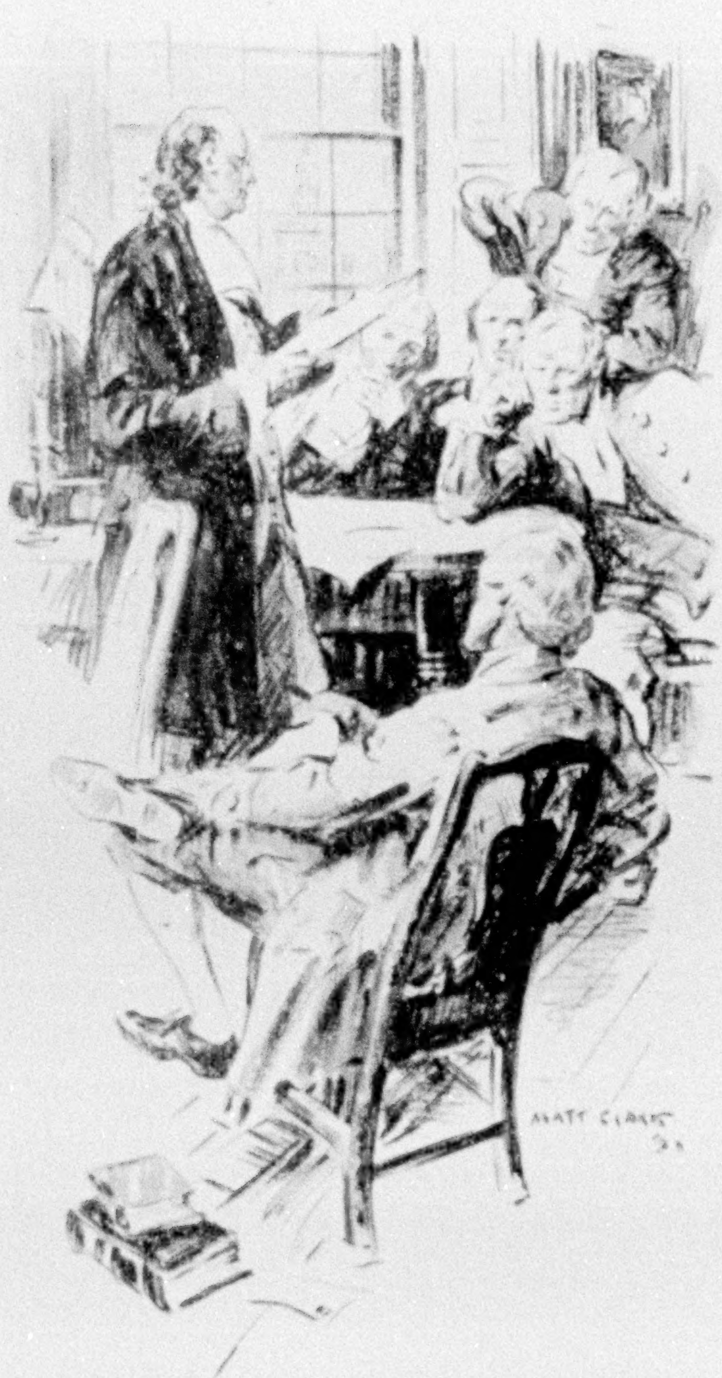

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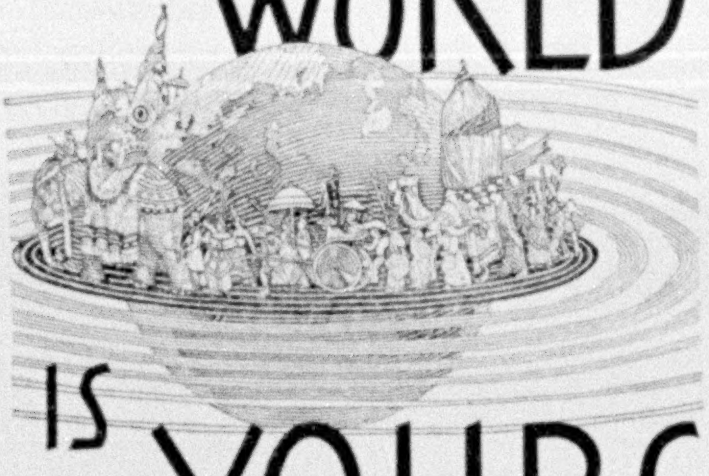

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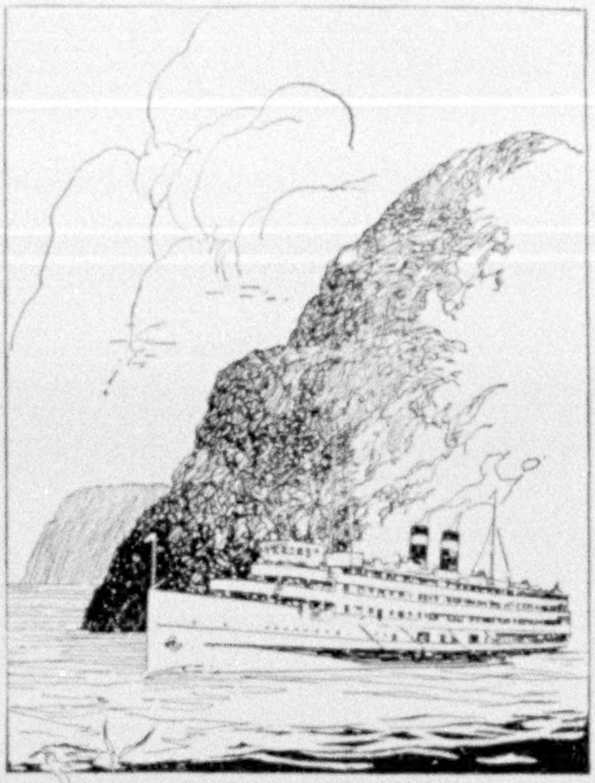

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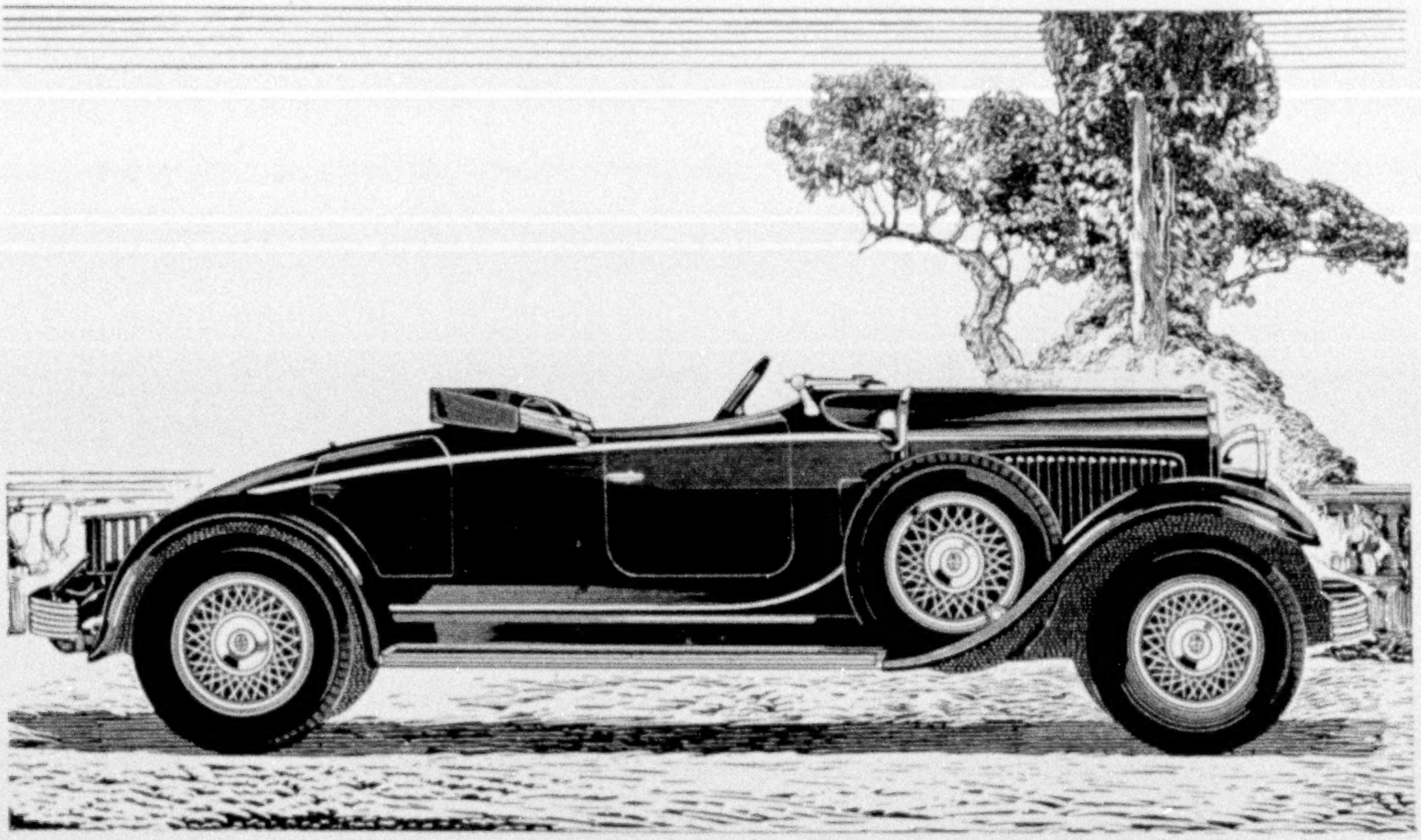

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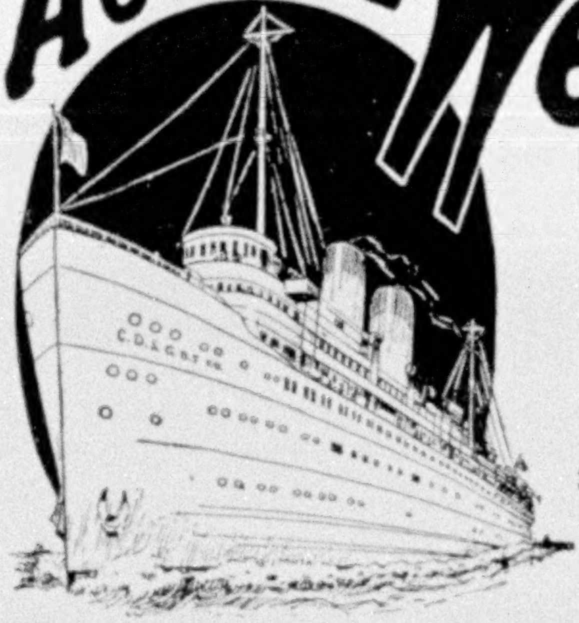

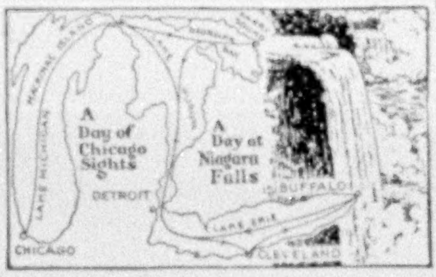

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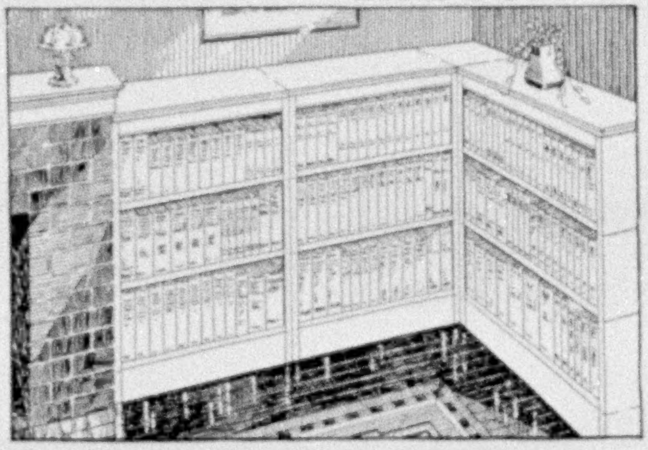

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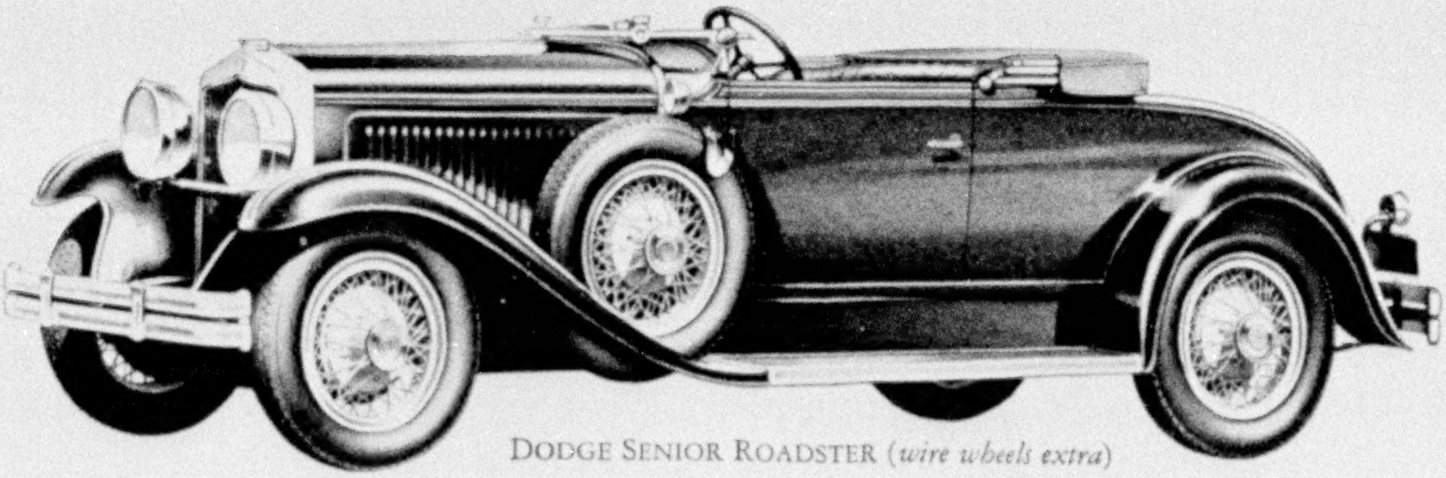

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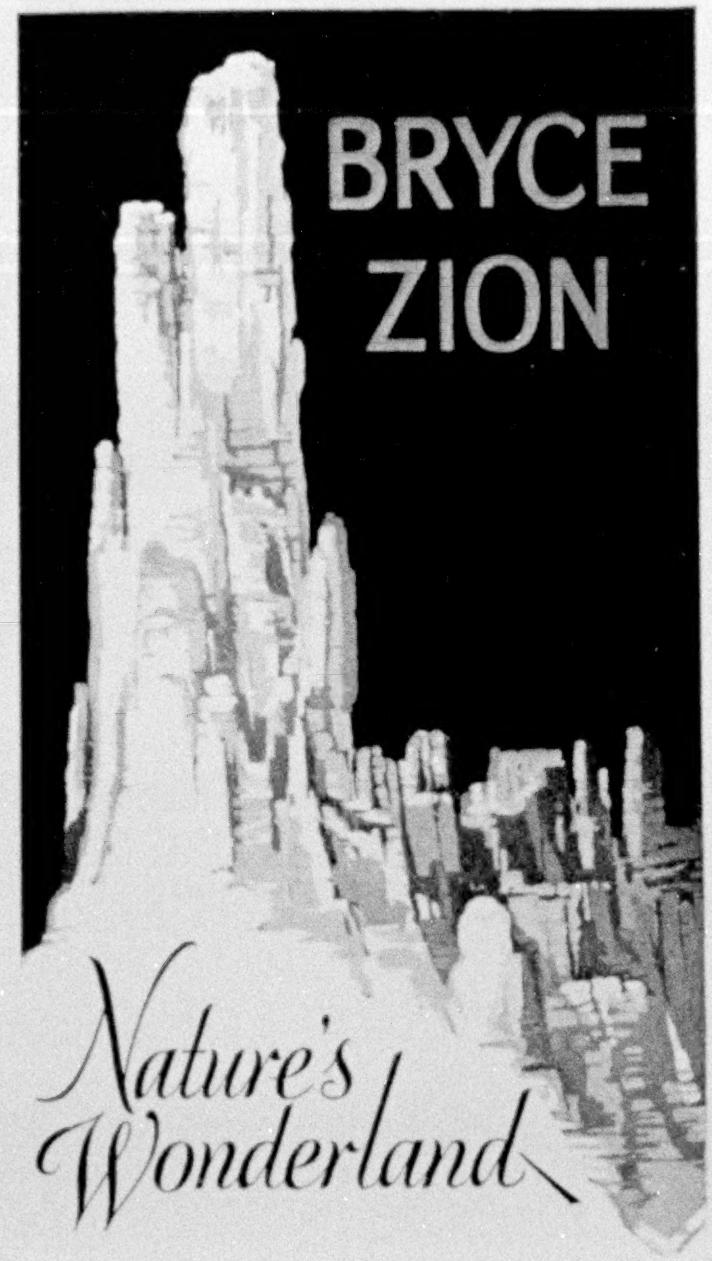

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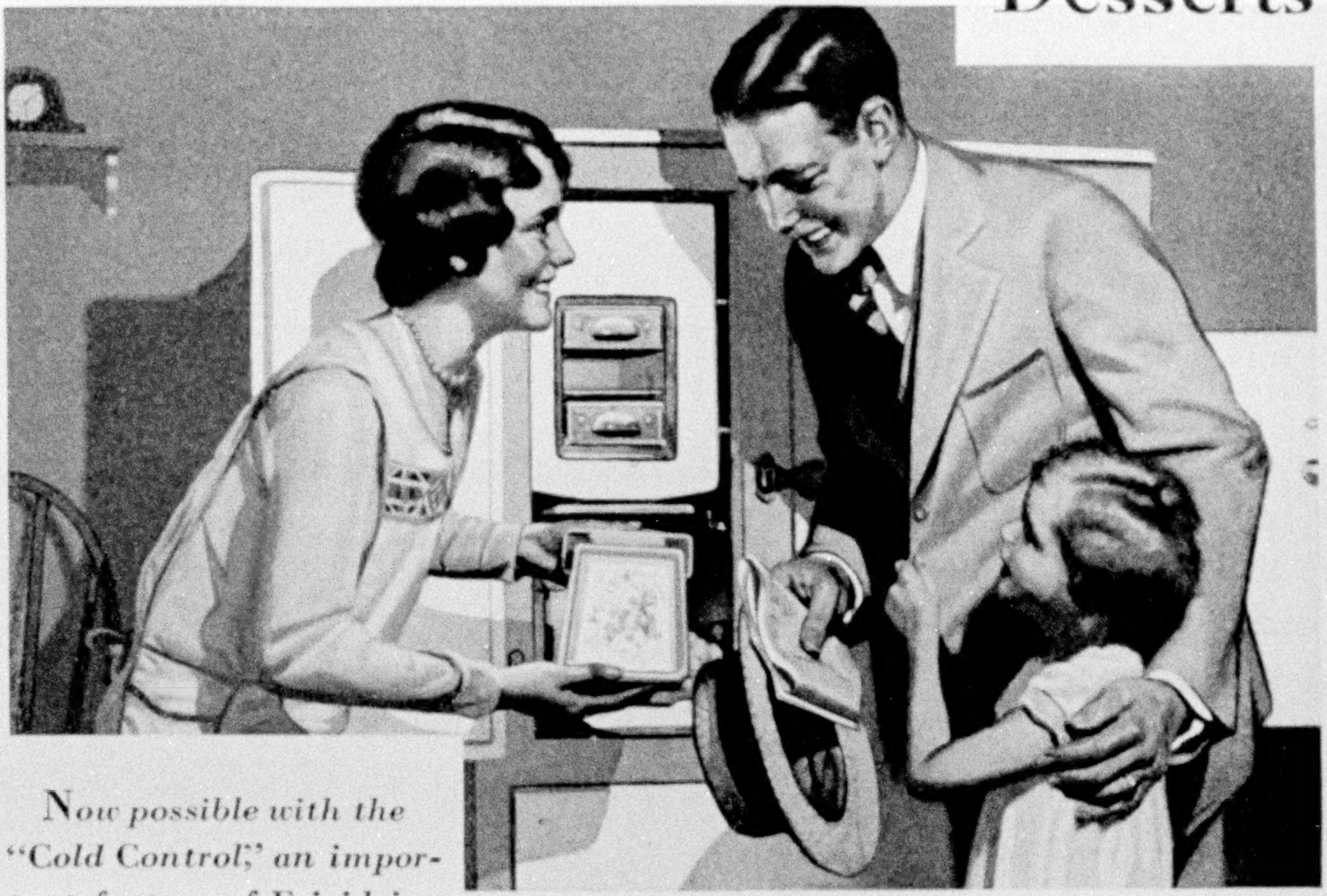

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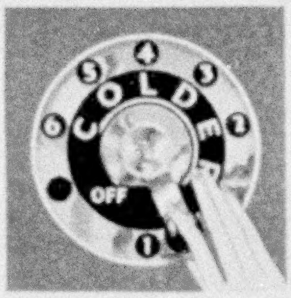

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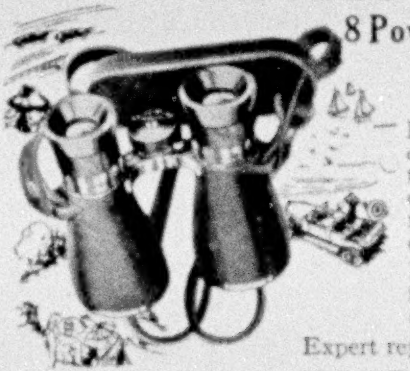

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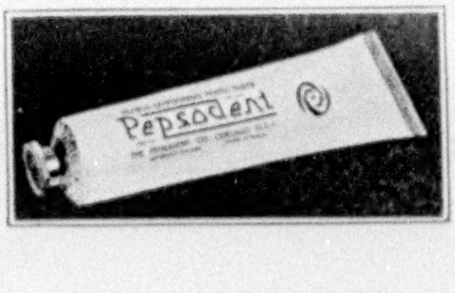

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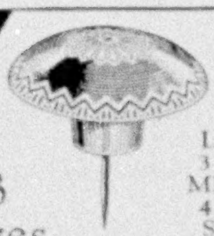

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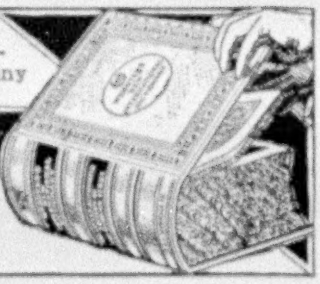

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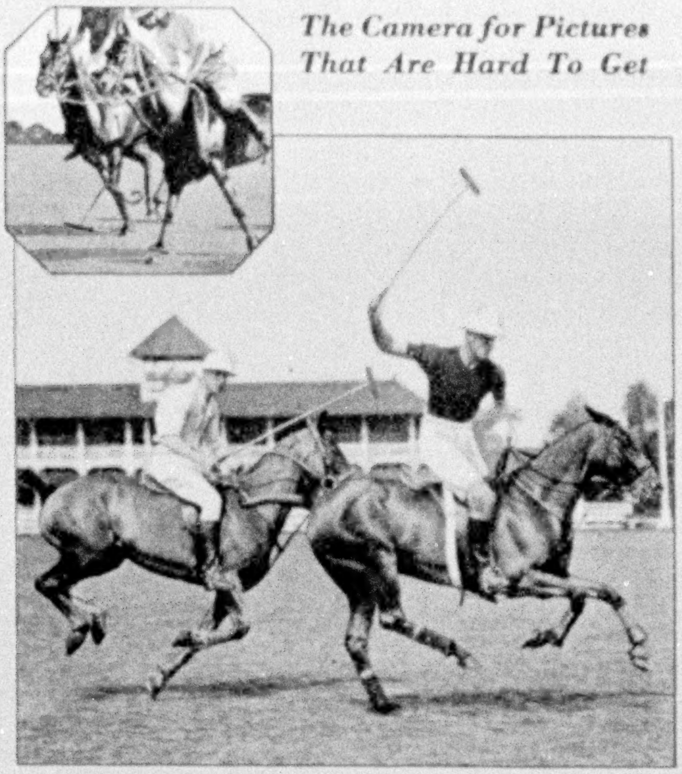

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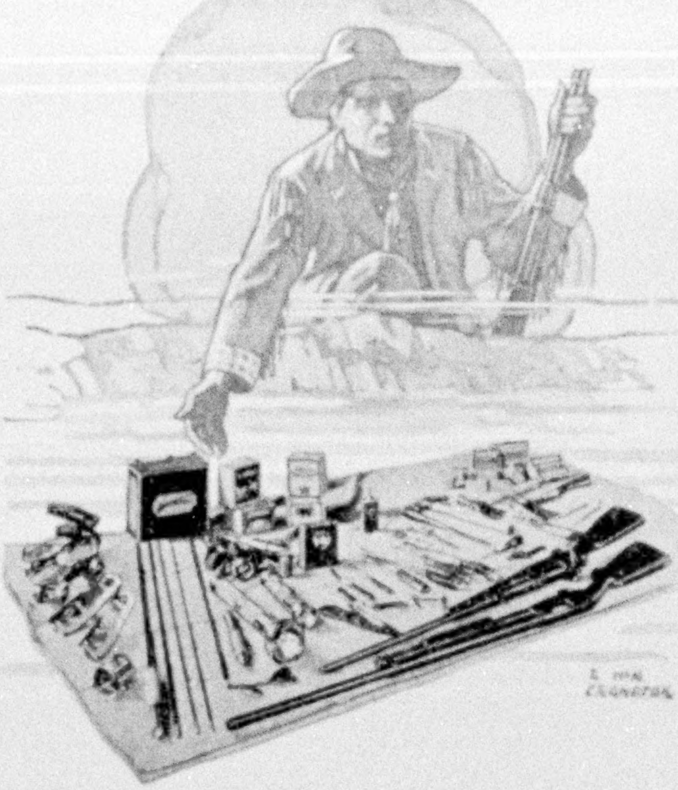

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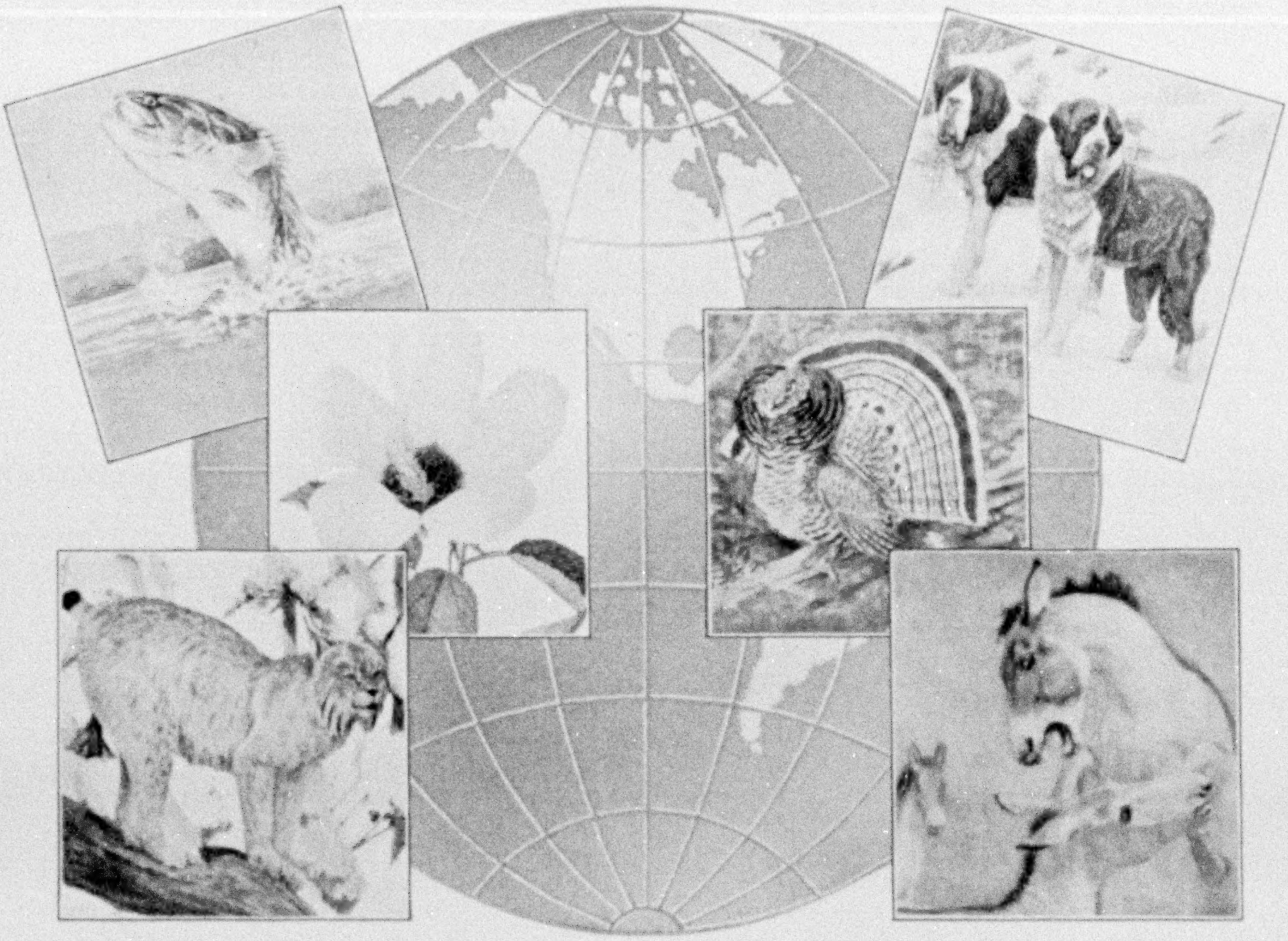

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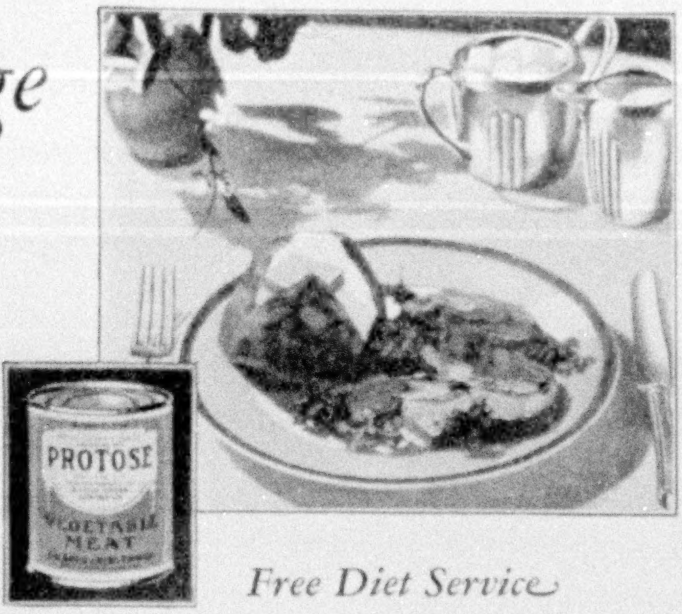

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This vegetable meat is one of the greatest contributions by the diet specialists at Battle Creek.

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Ask about Lacto-Dextrin, Psylla, Savita, Malted Nuts, Zo, Paramels, Fig Bran, Laxa, Vita Wheat and Bran Biscuit.

Free Diet Service

At Battle Creek we maintain a staff of graduate dietitians to advise you on any diet problem. If you will write to Ida Jean Kain, our chief dietitian, she will send you suggestions for your particular diet. "Healthful Living," a most interesting and helpful book written by a leading nutrition expert, will be sent free if you write your name and address on the margin of this ad and send it to us. It describes with recipes many of the foods used in the Battle Creek Diet System. THE BATTLE CREEK FOOD CO., Department 12B, Battle Creek, Mich.

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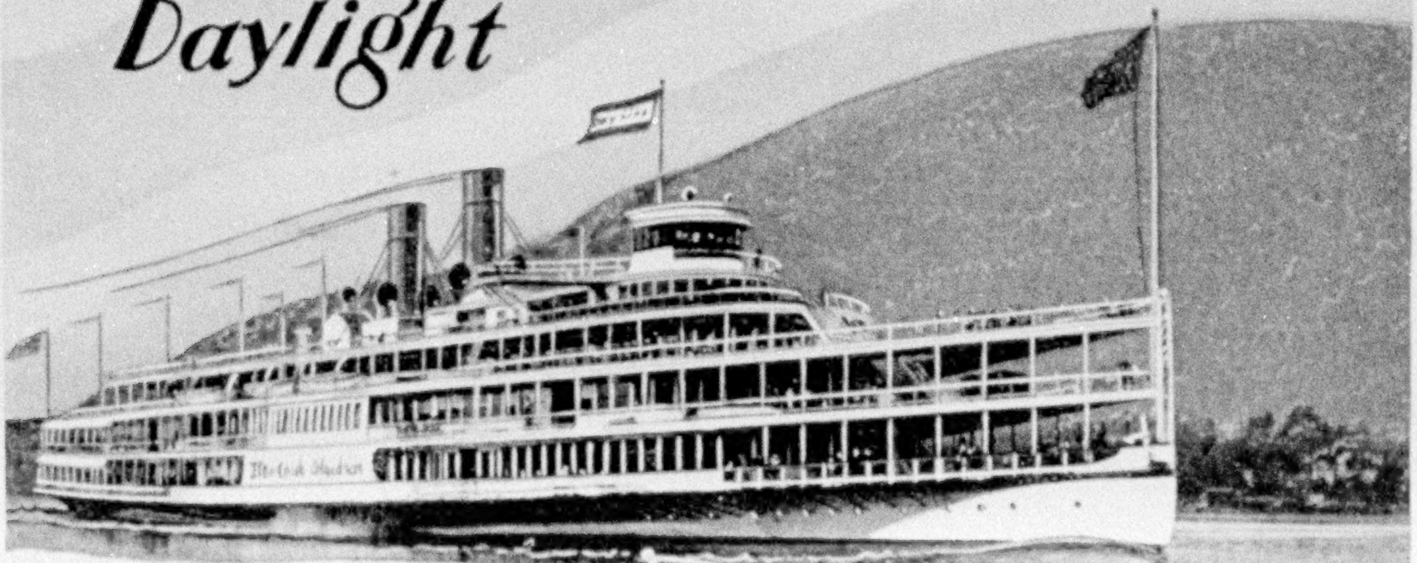
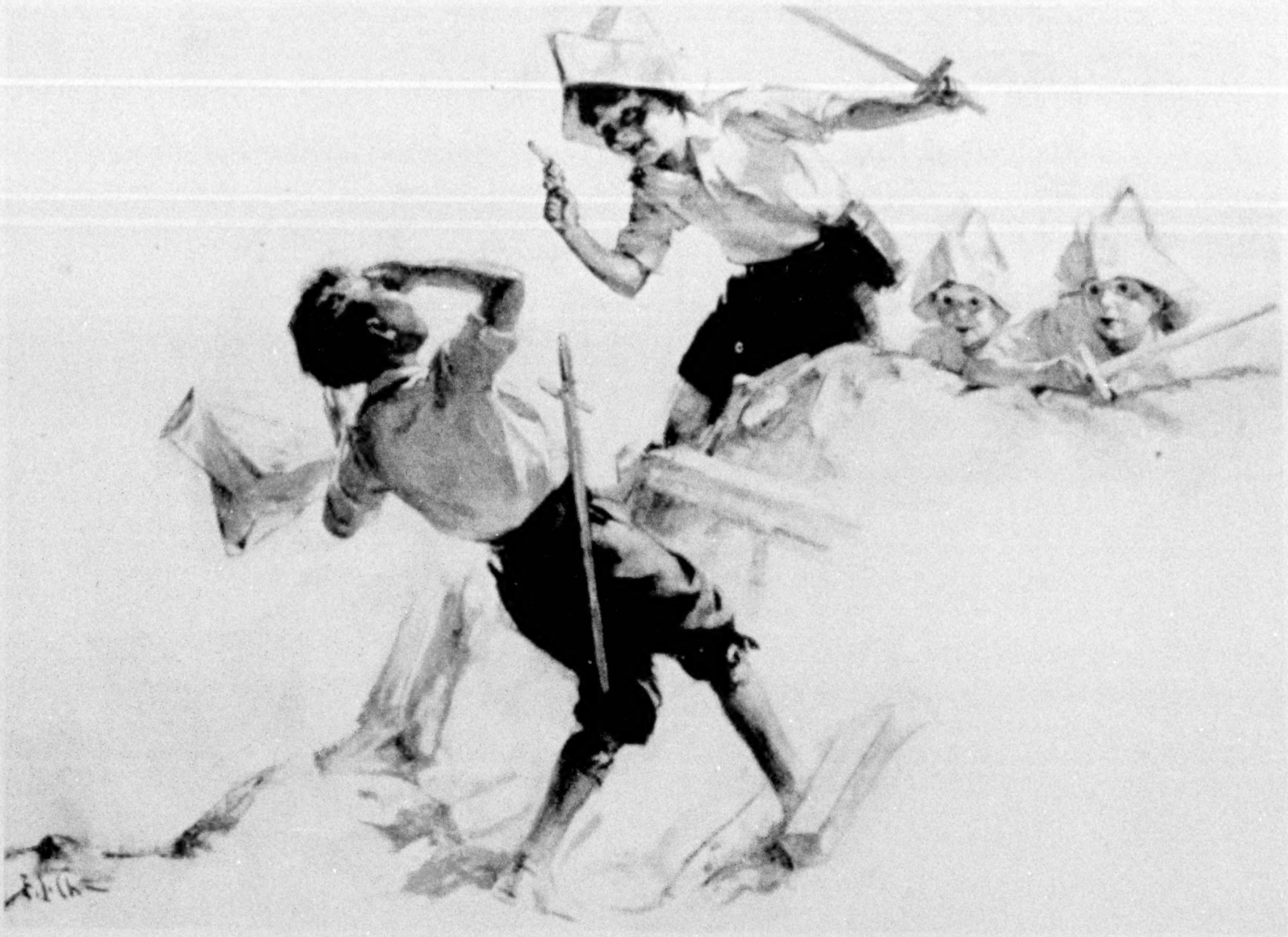


Hudson River Day Line **Day Line**
West 42nd Street Pier
New York City



"You're out, Jimmy Harrison!"

Storming the heights a la Anthony Wayne! Little hearts jump, tin swords flash . . . a toy pistol barks full in Jimmy Harrison's face.

"You're out," cries the attacking general—and Jimmy, hardened veteran that he is, carelessly rubs a slight "burn," and gracefully plays dead.

* * *

Unless Jimmy's mother calls the doctor at once, that slight, burning wound may prove dangerous. For whenever foreign matter is forced into the flesh away from the air, lockjaw, which the medical profession knows as tetanus, may take its deadly toll.

It may be the traditional rusty nail or toy pistol, but these are only among the more common causes.

In fact, the germ that brings lockjaw is found in many places. Every parent should be on the lookout to make sure that suspicious wounds receive immediate medical attention.

In the early months of the World War tetanus infection among wounded soldiers was appalling. Then all the warring nations issued a bulb of the preventive antitoxin as standard equipment in the First Aid kit of every man. As a result, medical authorities estimate, tetanus among the fighting men was reduced by approximately 85%.

Constant research by Parke-Davis scientists both before and since the war has steadily improved the quality of Parke-Davis tetanus antitoxin.

With modern preventive measures easy of access, one hears less and less about lockjaw developing from accidental wounds.

* * *

For over half a century Parke, Davis & Company have been powerful allies of the scientific forces that have contributed so greatly to improved medical practice.

Medical preparations bearing the Parke-Davis label have been prescribed by physicians with perfect confidence since our beginning 63 years ago.

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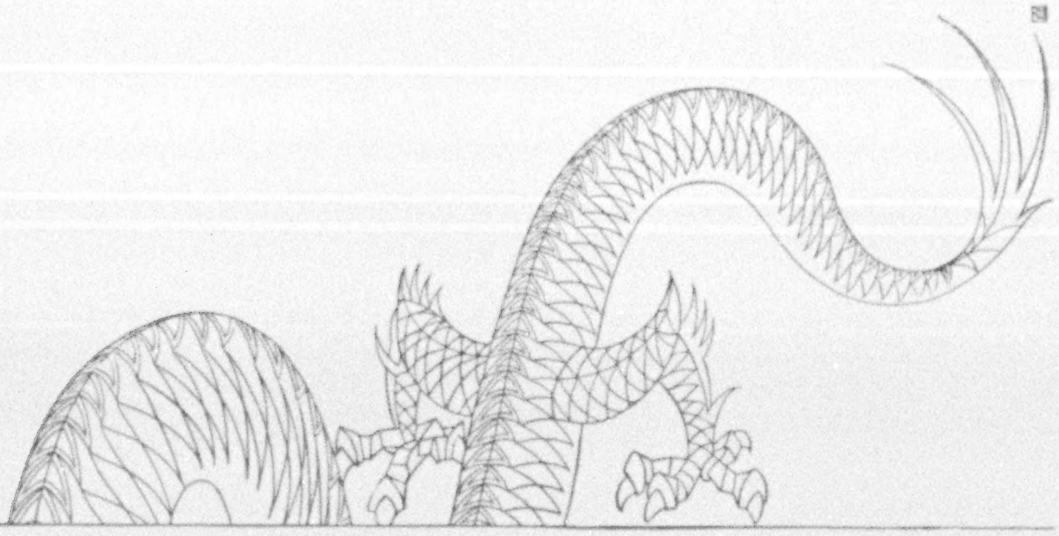

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If germs as huge as dragons roamed your rugs, with what awe you would regard the instrument which devoured them! But germs are none the less terrifying because they are infinitely small. Nor is the marvel less because The Hoover removes them so easily.

Rather it is greater, for the ability of The Hoover to gather up, in its cleaning, millions of these germs only shows how thoroughly it removes *all* types of dirt from your floor coverings.

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It enables The Hoover to remove more *dirt per minute* than any other cleaner.

Ask your local Hoover dealer for a home demonstration of "Positive Agitation." Three Hoover models, $59.50, $75 and $135. Only $6.25 down. Allowance for old cleaners.

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The accurate measure of electric cleaner efficiency is dirt per minute

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The Perfect Image
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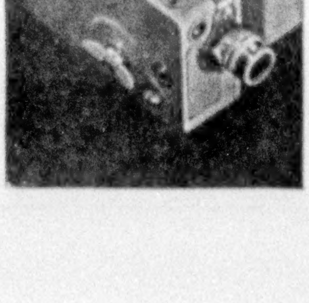
HOME MOVIES IN FULL COLOR

IMAGINE that the picture on this page had suddenly come to life. The horse shakes his head—a wisp of auburn hair blows out from under the girl's colorful hat . . . a flush of vibrant color rises in her cheeks . . . she smiles . . . her white teeth flash against a ruby background.

Here is *action.* Here is *color.* Combined, they make the perfect *living* image—an image that home movies, thanks to Kodacolor, the sensational new Eastman achievement, will permanently record. For with a Ciné-Kodak, Kodacolor Film and the Kodacolor Filter, you or anyone else can take beautiful movies in full, natural color. It is simplicity itself—a modern miracle. Eastman Kodak Company, Rochester, N. Y.